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[Early Fire Engines]

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A BRIEF ACCOUNT OF THE LIFE, WRITINGS, AND INVENTIONS OF SIR SAMUEL MORLAND,

MASTER OF MECHANICS TO CHARLES THE SECOND.

[by J. O. Halliwell-Phillipps]

A very civil man, and an excellent scholar: modest and respectful: perfect in the Latin tongue: an ingenious mechanist.—WHITELOCKE.

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All that the Author has aimed at in the following pages has been to rescue from oblivion the actions and writings of a man, who ought long since to have held a distinguished situation in the scientific annals of Great Britain.

Prior to the appearance of the biography of Sir Samuel Morland in Chalmers' Dictionary, no notice whatever had been taken of him: the reason of this neglect being probably owing in a great measure to the scarcity of his works. The above-mentioned article, though tolerably accurate with respect to his life, is very incorrect in other matters, as may be readily seen by comparing it with the following pages.

A short tract on Arithmetic is inserted at the end, not that it has any reference to the subject of our memoir, but because it appeared to be a seasonable opportunity for rescuing a curious piece of antiquity from destruction.

Trinity College,
Feb. 1838.

LIFE

OF

SIR SAMUEL MORLAND.

SAMUEL MORLAND was the son of the Rev. Thomas Morland, of Sulhamstead-Bannister, near Reading in Berkshire, and born somewhere about the year 1625, as we learn from the preface to his "Urim of Conscience," published in 1695, where he says that he had then passed the seventieth year of his age.

Little is known of his early life except that he was educated at Winchester school, whence he removed to the University of Cambridge, and, according to Cole,[1] to Magdalen College, where he became acquainted with Bishop Cumberland.[2] He remained at Cambridge for nearly ten years, but never took any degree, and the probability is that his University career was very unprofitable.

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[1] Athenæ Cant. vol. M.

[2] Payne's Life of Cumberland, p. 5.

Soon after his departure from college, he entered upon some political affairs, which brought him into public notice. In the month of November 1653, he was sent, with Whitelocke and a retinue of other gentlemen, on the famous embassy to the Queen of Sweden: they returned in July 1654, but, though successful, their rewards were anything but satisfactory. Morland, a few months afterwards, became assistant to Thurloe, the secretary of Oliver Cromwell. He also took a prominent part in the attempt to relieve the sufferings of the poor people of Piedmont, being appointed "commissioner extraordinary for the distribution of the collected monies" by the Protector, who also made him one of the clerks of the signet in March 1665.[3]

During the time he remained with Thurloe, he was an eye-witness of several plots concocted between that statesman and Cromwell.[4] The most remarkable one to which he was privy, is that usually known as Sir Richard Willis's plot against the life of Charles the Second, and since it had a considerable influence on the future conduct of Sir Samuel, a full narration cannot be considered irrelevant in this place.

In the beginning[5] of the year 1659, Thurloe, Cromwell, and Sir Richard Willis, formed a design of ruining the king at one blow, by sending over messengers with plausible letters "to invite him to come over in a single ship, with only his two brothers and a few more, to a certain port in Sussex upon an appointed day, where they were promised to be received and supported by 500 foot at their first landing, and 2000 horse within one day after." This plot was discussed in Thurloe's office when Morland was at his desk apparently asleep: Welwood[6] says that Cromwell, when he saw him, drew his sword, and was only dissuaded from despatching him on the spot by the earnest solicitation of Thurloe, who assured him that Morland had sat up two nights together, and was certainly fast asleep. Disgusted at this proceeding he immediately determined to divulge the plot to the king, which he did by means of one major Henshaw, who was then imprisoned in the tower. The king, being thus cautioned, answered that "he could not be ready so soon as the appointed day," which gave the three projectors some apprehension and suspicion of the discovery. Not being satisfied, however, with this answer, Willis was appointed to contrive other letters, urging his majesty "to use expedition, and not lose so fair an opportunity for his happy restoration." The king answered that he was not very well, or something that appeared so frivolous, that they justly concluded their whole project was discovered, and Willis was suspected of having divulged it. Under these circumstances Willis sent for Morland, who went, not considering it safe to decline the meeting, but took two pocket-pistols with him. At the appointed place, he was met by another person, by whom he was conducted with the utmost caution into a dark deep cellar, where by the light of a candle he saw Sir Richard by himself with a bible before him. Sir Richard told him plainly that "he had sent for him on account of the discovery of a secret of the highest importance, which could not possibly be known to more than three persons besides himself." Then, recounting the particulars, he laid his hand upon the bible, and solemnly swore that he had not been the discoverer, and requested him to do the same. Morland, seizing one of his pistols, told him "he was ready to do so, if he would give him a reason why he should suspect him." All this he did with such a remarkable presence of mind that Willis was completely damped, and Morland escaped from further interrogation. In May 1660,[7] he went to the king at Breda, who received him kindly, made him a knight, and soon afterwards a baronet.

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[3] MS. Harl. M.B. 7502, vii.

[4] Autobiography, MS. Lambeth, 931.

[5] Birch's Life of Thurloe.

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[6] Memoirs, ed. 1700, p. 11.

Echard[8] produces a letter from Sir Samuel to Willis, dated March the 10th 1660, in which he expressly denies the whole of the above. No credit, I conceive, must be given to it, since we have Morland's own testimony to the contrary in his autobiography: or, if he did write it at all, it was probably as a means of safety from the wrath of Willis.

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[7] Lower's Journal, p. 12; Kennet's Register, p. 135.

[8] Hist. of England, p. 728; Harris's Life of Crom. vol. i. p. 229.

On the restoration of Charles he was made Master of Mechanics to his Majesty, who also presented him[9] with a medal as an "honorable badge of his signal loyalty." On one side of it was the king's head laureat, with this legend, "Carolo II. Regi institutori Aug.;" in the table of the reverse, "In adversis summo vitæ periculo in prosperis felici ingenio frequens adfuit." He was soon afterwards made a gentleman of his Majesty's privy chamber.

During the remainder of his life he employed himself entirely with mechanical experiments, &c. In 1677 he took a lease of a house[10] at Vauxhall, for twenty-one years, from the heirs of Jane Vaux, the daughter of Guy Vaux, of gunpowder celebrity. This house was situated where Vauxhall Gardens now are.[11] Two years afterwards, he had a pension of £400 settled upon him, but some embarrassment in his affairs obliged him to sell it. He afterwards removed to a house at Hammersmith, near the water-side, where he died December the 30th, 1695, and was buried in Hammersmith chapel on January the 6th of the following year.[12]

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[9] Evelyn's Numismata, p. 141.

[10] On the top was a Punchinello holding a dial. (Aubrey's Surrey, vol. i. p. 12.)

[11] Manning's Surrey, vol. 3, p. 489.

The three last years of his life were spent very wretchedly. Poverty and loss of sight compelled him to rely almost solely on the charity of Archbishop Tenison. He returns him thanks for his kindness, in a letter dated March 5th, 1694, which was far greater, says Sir Samuel, "than such a poor wretch as I could ever hope for." Evelyn, in his diary, gives an interesting description of him when harassed with this accumulated load of misfortunes.

"25th Oct. 1695.—The Archbishop and myself went to Hammersmith to visit Sir Samuel Morland, who was entirely blind; a very mortifying sight. He shewed us his invention of writing, which was very ingenious; also his wooden calendar, which instructed him all by feeling, and other pretty and useful inventions of mills, pumps, &c., and the pump he had erected, that serves water to his garden, and to passengers, with an inscription, and brings from a filthy part of the Thames near it, a most perfect and pure water. He had newly buried £200 worth of music-books, being, as he said, love songs and vanity. He plays himself psalms and religious hymns on the Theorbo."

The inscription which Evelyn refers to was on a stone tablet fixed in the wall, and is still preserved; the following is a copy of it: "Sir Samuel Morland's well, the use of which he freely gives to all persons: hoping that none who shall come after him, will adventure to incur God's displeasure, by denying a cup of cold water (provided at another's cost and not their own) to either neighbour, stranger, passenger, or poor thirsty beggar. July 8, 1695."

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[12] Gent. Mag. 1818, part II. p. 12.

Sir Samuel married three times: he was divorced from his last wife in 1688. One daughter of the name of Anne was buried at Kensington church, March 2, 1670, and another named Susanna was baptized at Norwood, February 28, 1666. The monuments of his two first wives are in Westminster Abbey.

But Morland's principal claims to the notice of posterity are his writings and mechanical inventions: these I shall place as nearly as possible in chronological order, and I have endeavoured to be impartial, having given the various claims to the same inventions, which have been brought forward by others.

From some correspondence between Morland and Dr. Pell, preserved in the British Museum,[13] it appears that Sir Samuel, as early as 1666, had intended to publish a work on the quadrature of curvilinear spaces, and had actually proceeded to print part of it, when, by the advice of the latter, he was persuaded to lay it aside altogether. In the rough draft of a letter to

[13] MS. Birch, 4279.

Morland, dated April the 7th, 1666, in giving his opinion on the portion of the work already printed, Pell says, "The love which I beare to truth and to the author of those papers does constraine me to desire that they may rest awhile unpublished." Morland not only yielded implicitly to his directions, but, in a letter written a short time afterwards, he furnishes arguments against some propositions in his own treatise: "I should desire," says he to Pell, "to bee altogether mute, and to submitt to your judgement in all things." Pell in another place[14] informs us that Morland's "cyclometrical papers are two: one a copper-plate, the other a Latin discourse on it."[15]

It was about this period that he invented his arithmetical machines, which he makes mention of in a letter dated May 13, 1666.[16] He did not, however, publish an account of them before 1673, when, "by the importunity of his very good friends," they were made public. The little work in which they are described is illustrated with twelve plates, in which the different parts of the machine are exhibited. Its operations are conducted by means of dial plates and small indices, moveable with a steel pin. By these means the four fundamental rules of arithmetic are very readily worked, and, to use the author's own words, "without charging the memory, disturbing the mind, or exposing the operations to any uncertainty." His "perpetual almanac" is given at the end, which was reprinted by Playford in his "Vade Mecum."

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[14] MS. Birch, 4407.

[15] They became acquainted in Switzerland, but Morland tells us that he saw Pell for the first time at Colonel Montagu's chambers at Whitehall. See MS. Lansd. 751, folio 399.

[16] MS. Birch, 4279.

From Dr. Pell's collections in the British Museum,[17] it appears that Dr. Hooke had invented about the year 1670, an "engine for multiplying and dividing." The Marquis of Worcester[18] also, in his Century of Inventions, seems to refer to a similar machine: he calls it "an instrument whereby persons ignorant in arithmetic, may perfectly observe numerations and subtractions of all sums and fractions."

Most biographers assert that he invented the fire-engine, but he ought to be considered rather an improver than an inventor of that machine. As early as 1590, Cyprian Lucar, in his "Treatise named Lucarsolace," gave a description of a rude fire-engine which he designated by the name of a squirt: this engine consisted of a large hollow cone, moveable on a wooden frame, and open at the vertex, into which is inserted a long pipe for the passage of the water, which being continually thrown into the cone through a funnel near the vertex, is ejected by a piston at the other extremity, on a principle precisely similar to that of the common squirt. Evelyn also mentions a fire-engine invented by Greatorix in 1656, which was ten years before he saw the "quench-fires" of Sir Samuel.

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[17] MS. Birch, 4422, folio 67. See also Hooke on the first part of Mach. Cœl. Hevelii, p. 45.

[18] Gent. Mag. 1748, p. 109.

We are, however, certainly indebted to Morland for the speaking-trumpet, an account of which instrument he published at London in 1671, under the title of "A description of the Tuba-stentorophonica, an instrument of excellent use, as well by sea as by land." In this rare tract, consisting of eight leaves, he gives an account of the various experiments that he made before his instrument attained a certain degree of perfection. The first trumpet that he constructed, although, says Sir Samuel, "the invention had been long before digested in my thoughts," was made in glass in the year 1670, being about 2 feet 8 inches in length, the diameter of the greater end 11 inches, and that of the other end 2½ inches: "with this," he says, "I was heard speaking at a considerable distance by several persons, and found that it did very considerably multiply the voice." After giving a description of some experiments with other trumpets, he enters into a philosophic disquisition on the nature of sound, and the best form of the speaking-trumpet, which he leaves doubtful, and concludes with "an account of the manifold uses" of his instrument, which are very excusably magnified: he appears also to have overrated the power of his trumpet, for, in his

"Urim of Conscience," he says that he has no doubt but what it might be improved so as to carry the voice for the distance of ten miles. A French translation of Morland's tract was published at London in 1671, and, in an advertisement prefixed, it is stated that Morland's tubes were sold by Moses Pitt, a bookseller in St. Paul's church-yard, at the price of £2. 5*s*.

The principal objects of Sir Samuel's study were water-engines, pumps, &c., which he carried to a high degree of perfection: his pumps brought water from Blackmore Park near Winkfield to the top of Windsor Castle. A bill to enable him "to enjoy the sole benefit of certain pumps and water-engines by him invented," was read the first and second times in the House of Commons, on the 12th and 13th of February 1674, but it did not pass: he obtained, however, a patent for them in the course of the following year. In 1697, two years after his death, a tract by him was published at the expence of his son: it is entitled "Hydrostatics; or, instructions concerning water-works," and contains an account of his various methods of raising water, besides tables of square and cube roots: from the close of Joseph Morland's preface, it appears that many of his father's works were still left unpublished. There is also a treatise by Sir Samuel, in the Harleian collection of manuscripts, which is entitled "Elevation des eaux, par toute sorte de machines, reduite a la mesure au poids, et a la balance: Presentée a sa majeste tres Chretienne, 1683:" at page 35 commences a very short tract on the steam-engine, entitled "The principles of the new force of fire invented by Chev. Morland in 1682, and presented to his most Christian Majesty, 1683;" and these principles are explained as follows:—"Water being converted into vapour by the force of fire, these vapours shortly require a larger space (about 2000 times) than the water before occupied, and rather than be constantly confined would split a cannon. But being duly regulated according to the rules of statics, and by science reduced to measure, weight, and balance, then they bear their load peaceably (like good horses) and thus become of great use to mankind, particularly for raising water, according to the following table, which shews the number of pounds that may be raised 1800 times per hour to a height of six inches by cylinders half filled with water, as well as the different diameters and depths of the said cylinders:" then follows his table of the effects of different sized cylinders.[19] This evidently indicates a knowledge of the subject, and we may, I think, fairly presume that he was probably the first who actually constructed a steam-engine, although his allusion to the force of steam being sufficient to burst a cannon appears to intimate that he was not a stranger to the volume which the Marquis of Worcester had published some years previously. To his great credit also, let it not be forgotten that he has correctly stated the increase of volume which water occupies in a state of vapour, which must have been the result of experiment: his researches, however, seem to have had little influence on the progress of the practical application of steam.

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[19] Tredgold on the Steam-engine, p. 4.

I shall now briefly notice his miscellaneous treatises. In 1658 he published his "History of the Evangelical Churches of Piedmont," which was drawn up at the request of Archbishop Usher, and contains a most exact geographical description of the place, and a faithful account of the doctrine, life, and persecutions of the ancient inhabitants; it possesses a print of the author by Lombart after Lilly, with his arms underneath.[20] According to Beughem, he wrote "Articles and rules for the better government of his majesty's forces by land during this present war;" but I have never seen it, nor do I know what war is referred to. His "Doctrine of interest both simple and compound," published in 1679, is a very praiseworthy little volume, and the tables are very accurately calculated, but his "New rule for the equation of payments" is erroneous: another tract by him, consisting of four leaves, and entitled "The Count of Pagan's method of delineating all manner of fortifications (regular and irregular) from the exterior poligone reduced to English measure and converted into Hercotectonick lines," was published in 1672, in Venn's "Military and Maritime Discipline." The "Urim of Conscience," which has already been mentioned, was written during his blindness, and is a very singular piece of composition: it contains reflections on the fallen state and insignificance of man, and the uncertainty of life. By one of his letters, dated 28th of July, 1688, it appears also that he had an intention of publishing the first six books of Euclid for the use of public schools.

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[20] Ar: on two bars sable, three leopards faces jessant, fleurs de lis. When he was made a Baronet they were altered to sable a leopard's head jessant a fleurs de lis, or.

Morland is said to have written a treatise on the barometer, which was answered by Lord North in another tract on the same subject: I have seen neither of them.

He is also said to have invented the capstan to heave up anchors, but he must be considered rather an improver than the inventor of that machine: the same remark will apply to various other performances, which have at various times been attributed to him.

A TREATISE

ON THE

NUMERATION OF ALGORISM,

FROM A MS. OF THE 14TH CENTURY.

To alle suche even nombrys the most have cifrys as to ten. twenty. thirtty. an hundred. an thousand and suche other. but ye schal vnderstonde that a cifre tokeneth nothinge but he maketh other the more significatyf that comith after hym. Also ye schal vnderstonde that in nombrys composyt and in alle other nombrys that ben of diverse figurys ye schal begynne in the ritht syde and so rekene backwarde and so he schal be wryte as thus—1000. the cifre in the ritht side was first wryte and yit he tokeneth nothinge no the secunde no the thridde but thei maken that figure of 1 the more signyficatyf that comith after hem by as moche as he born oute of his first place where he schuld yf he stode ther tokene but one. And there he stondith nowe in the ferye place he tokeneth a thousand as by this rewle. In the first place he tokeneth but hymself. In the secunde place he tokeneth ten times hymself. In the thridde place he tokeneth an hundred tymes himself. In the ferye he tokeneth a thousand tymes himself. In the fyftye place he tokeneth ten thousand tymes himself. In the sexte place he tokeneth an hundred thousand tymes hymself. In the seveth place he tokeneth ten hundred thousand tymes hymself, &c. And ye schal vnderstond that this worde nombre is partyd into thre partyes. Somme is callyd nombre of digitys for alle ben digitys that ben withinne ten as ix, viii, vii, vi, v, iv, iii, ii, i. Articules ben alle thei that mow be devyded into nombrys of ten as xx, xxx, xl, and suche other. Composittys be alle nombrys that ben componyd of a digyt and of an articule as fourtene fyftene thrittene and suche other. Fourtene is componyd of four that is a digyt and of ten that is an articule. Fyftene is componyd of fyve that is a digyt and of ten that is an articule and so of others . . . . . . But as to this rewle. In the firste place he tokeneth but himself that is to say he tokeneth but that and no more. If that he stonde in the secunde place he tokeneth ten tymes himself as this figure 2 here 21. this is oon and twenty. This figure 2 stondith in the secunde place and therfor he tokeneth ten tymes himself and ten tymes 2 is twenty and so forye of every figure and he stonde after another toward the lest syde he schal tokene ten tymes as moche more as he schuld token and he stode in that place ther that the figure afore him stondeth: lo an example as thus 9634. This figure of foure that hath this schape 4 tokeneth but himself for he stondeth in the first place. The figure of thre that hath this schape 3 tokeneth ten tyme himself for he stondeth in the secunde place and that is thritti. The figure of sexe that hath this schape 6 tokeneth ten tyme more than he schuld and he stode in the place yer the figure of thre stondeth for ther he schuld tokene but sexty. And now he tokeneth ten tymes that is sexe hundrid. The figure of nyne that hath this schape 9 tokeneth ten tymes more than he schulde and he stode in the place ther the figure of 6 stondeth inne for thanne he schuld tokene but nyne hundryd. And in the place that he stondeth inne nowe he tokeneth nine thousand. Alle the hole nombre of these foure figurys. Nine thousand sexe hundrid and foure and thritti.

The foregoing tract is written on a single leaf of vellum, which was found loose in an ancient manuscript on Astronomy in my possession, and is curious inasmuch as it is the most ancient piece on arithmetic in the English language that has hitherto fallen under my observation: in the British Museum there are none written in English of a date prior to the sixteenth century.

The division of numbers into digits, articules, and composites, belongs probably to a very ancient period: I find it in a treatise on arithmetic mentioned by Wallis, and which is now in the Bodleian Library at Oxford: the first chapter of it is given here on account of its similarity with the above.

"Hæc algorismus ars præsens dicitur: in quâ
Talibus Indorum fruimur bis quinque figuris.
0 . 9 . 8 . 7 . 6 . 5 . 4 . 3 . 2 . 1.
Primaque significat unum, duo vero secunda;
Tertia significat tria; sic procede sinistra
Donec ad extremam venis, quæ cifra vocatur.
Quodcunque illarum si primo limite ponas
Simpliciter se significat; si vero secundo
Se decies: sursum procedas multiplicando:
Nil cifra significat: dat significare sequenti.
Post hæc dicta, scias breviter quæ tres numerorum
Distinctæ species sunt. Nam quidam digiti sunt;
Articuli quidam; quidam quoque compositi sunt.
Sunt digiti numeri qui semper infra decem sunt;
Articuli decupli digitorum; compositi sunt
Illi qui constant ex articulis digitisque.
Ergo proposito numero tibi scribere; primo
Respicias quis sit numerus: quia si digitus sit
Una figura satis ei; sed si compositus sit,
Primo scribe loco digitum post articulumque
Si sit articulus, in primo limite cifram,
Articulum vero in limite scribe sequenti.
Septem sunt partes non plures istius artis.

Addere, subtrahere, duplareque dimidiare;
Sextaque dividere est, sed quinta est multiplicare;
Radicem extrahere pars septima dicitur esse.
Subtrahis aut addis a dextra vel mediabis.
A leva dupla, divide, multiplicaque;
Extrahe radicem semper sub parte sinistra."

This tract has been ascribed to Sacro-Bosco, but on what ground I know not: a copious commentary on it in the British Museum was written in 1451, so that it must have been composed some considerable time before that period. It concludes thus: "Et sic finit tractatus de arte algorismi ad laudem et gloriam ipsius qui vivit et regnat in seculum seculorum. Amen. Scriptus per manum A. W. anno Domini millesimo CCCC. quingesimo primo."

From the numerous MSS. of it which remain, we might be led to infer that it was of great antiquity, and a copy in Gale's collection ascribes it to Dionysius Exiguus: it has also been considered of English origin, because many transcripts possess notes on the margin in that language, but that is not at all conclusive: the number of foreign MSS. transported into England at that period was very great; for instance, we are told by Daniel Morley, in the dedication of his treatise "De inferiori et superiori parte mundi," (MS. Arund. 377, folio 88.) to the bishop of Norwich, that he returned from Spain to England "cum preciosa multitudine librorum."

The two commencing lines of the foregoing poem have given rise to much controversy among authors who have written on the introduction of the Arabic numerals into Europe: Professor Peacock considers it to belong to the fifteenth century, but I find it quoted in Sacro-Bosco's treatise on the same subject, which was composed about 1250, and therefore it must have been written before then. Moreover, in the library of Corpus Christi College, there is an ancient MS. of this poem in the French language.[21]

A curious MS. on arithmetic in the library of Trinity College[22] refers these numerals to a Chaldean origin: it is entitled "compendiosa subtilitas multiplicationis," and commences thus: "Cirta Algorismum primo docendum procedere: secundo addere: tertio subtrahere: quarto duplare: quinto dimidiare: sexto multiplicare: septimo et ultimo dividere. Processio est quod quelibet figura quo loco posita habeat significare. Sunt igitur novem figuræ que secundum Chaldeos sinistro sunt scribendæ. Quæ tales sunt .9.8.7.6.5.4.3.2.1. Est autem decima figura que quamvis nichul significat per se tam secundum locum optinens aliis confert significare quæ talis est 0."

The word Algorism is of Arabic origin, although stated by many early authors to have derived its name from Algus, its supposed inventor.[23] It need scarcely be mentioned that in the middle ages all scientific knowledge was received from the Arabs, and I am acquainted with only one instance in which a mathematical author of that period has stated his means of information to be derived from a Greek source. The work to which I refer is a very ancient one on Astronomy, the commencement of which is as follows:—"Here begynnis ye wyse book of phylosophye and of astronomye conteyned and mad of XX wysest phylosoforys and astronomerys yat ever were syn ye world was begunne. That is for to saye in ye lond of grece For in yat lond an engelychman ful wys and wel vnderstandyng of phylosophye and astronomye stodyeth and compyled yis book out of grek into engelysch graciously."[24]

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[21] There are three MS. copies of it in the British Museum. Bib. Reg. 8 C. iv. et 12 E. I. i. and MS. Cott. Vitell. A. I. iv. which last contains only the first chapter as given above.

[22] MS. Gale. O. 2. 45. folio 37.

Numerical signs, or rather contractions, bearing a slight similarity to the Arabic numerals, are found in a very singular MS.[25] on Arithmetic, in the British Museum, which is said to belong to the twelfth century.[26] They consist of nine forms, and have names written over each of them, "not Greek, or Latin, or Arabic, or in any other known language," but having a little resemblance to the last. The principal deficiency is the absence of the cypher, but the writer was evidently acquainted with the decuple value which a digit receives by its situation on the left of another. I perfectly agree with Hallam, or rather the gentleman from whom he acknowledges to derive his information, in considering that in these contractions may be traced the elements of our own numerical notation.

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[23] John of Norfolk, in his "Summula progressionis," ascribes the invention of arithmetic to Algus: the author was of All Souls' College, at Oxford, as we learn from the close of his little treatise:—"Et sic perfectus iste est tractatus brevissimus in collegio animarum Oxoniæ Anno domini millessimo quadringentesimo quadragesimo quinto." MS. Harl. 3742.

[24] MS. Sloane B. M. 2453. 965. Also Bib. Reg. 17A. XXXII. A copy more ancient than any of these is in the author's possession.

[25] MS. Arund. 343. i.

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[26] Hallam's introduction to the literature of Europe during the Middle Ages, vol. i. p. 150.

APPENDIX.

In the expectation of finding some more particulars relative to Morland's Cyclometrical treatise, all Pell's manuscripts in Dr. Birch's collection in the British Museum have been carefully examined, and since they contain a great quantity of papers interesting to the mathematician, but which, from the very brief description in the catalogue, cannot be generally known to be there, a short abstract of the contents of the more important cannot but be acceptable.

Pell's MSS. in Ayscough's catalogue are numbered as follows: 4279, 4280, 4365, 4394, 4395, and from 4405 to 4431.

No. 4279 contains original letters to Dr. Pell from John Davis, Morland, and others, with the rough draft of Pell's answers; as also a letter from Walter Warner to Mr. Payne, dated Oct. 17th 1634. The next volume is filled principally with rough drafts of letters in answer to Cavendish and members of his own family. No. 4365 contains papers relating chiefly to Piedmont. No. 4394 consists of various loose papers, among which is one entitled "An inventorie of the papers of Mr. Warner," which John Collins, in a MS. note, states that he received from Dr. Thorndyke, December 14th, 1667. The only article deserving of notice in the following volume (4395) is a long letter from Henry Briggs to Pell, in which he mentions his "suddaine longe journey into the Northe," and answers some enquiries concerning logarithms which Pell had made in a former letter.

In No. 4405 is a curious tract on Logarithms by Pell, entitled "Imitatio Nepeiria:" at p. 132 is a letter dated from Cambridge, December 10th 1672, which, though it contains no signature, must have been written by Newton, and is curious inasmuch as it mentions his "newe method" of fluxions. No. 4408, though stated to be written by Pell, is wholly in the hand-writing of Nathaniel Torporley, and contains notes on the variation of the compass, triangular numbers, optics, &c.; it appears[1] also that the address "ad studiosos mathematicos," inserted at the end of Harriot's Algebra, was written by him: he quarrelled with Warner soon afterwards, and that probably occasioned his "Corrector analyticus artis posthumæ Thomæ Harrioti" in Sion College library, in which he calls Harriot "homo evanidus," meaning probably that his fame as a mathematician would not last for any length of time. The next volume is also by Torporley and contains solutions of algebraical and geometrical problems. No. 4410 contains Pell's original MS. of his letter to Theodore Haak concerning Easter, and from No. 4413, folio 24, it appears that the problem generally ascribed to Colonel Titus was proposed to Pell in 1649 by William Brereton, who very probably had it from Harriot. The remainder consist principally of imperfect mathematical papers, and, although they contain a few curious articles, yet they do not appear to be of sufficient importance to merit any further notice in this place: to the mathematical antiquary I would recommend a careful examination of all of them, under the conviction that there is enough of what is really curious and important to repay him well for his labour.

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[1] Torporley has added the following note:—"It will do well in this forme. And I leave it to Mr. Warner's discretion, whether he think it fit to give this mention or not, because he seemed to doubt of it." He afterwards wrote a tract against Harriot's Algebra, the MS. of which is in Sion College, and a volume of mathematical papers headed in Reading's catalogue of that library as "Algebraicæ, tabulæ sinuum, &c." is in his hand-writing: he gave his library to the college in 1633.

It may not be amiss here to enquire what became of Warner's papers mentioned at page 27. Pell in a letter[2] to Cavendish thus makes mention of them:—"Again as to Mr. Warner's analogickes of which you desire to know whether they be printed. You remember that his papers were given to his kinsman, a merchant in London, who sent his partner to bury the old man: himselfe being hindred by a politicke gout, which made him keepe out of their sight that urged him to contribute to the Parliaments assistance, from which he was exceedingly averse. So he was looked upon as one that absented himselfe out of malignancy, and his partner managed the whole trade. Since my comming over, the English merchants here tell me that both he and his partner are broken and now they both keepe out of sight, not as malignants but as bankrupts. But this you may better enquire among our Hamburgh merchants. In the meane time I am not a little afraid that all Warner's papers, and no small share of my labours therein, are seazed upon and most unmathematically divided betweene the sequestrators and creditors, who (being not able to balance the account where there appear so many numbers, and much troubled at the sight of so many crosses and circles in the superstitious Algebra and that blacke art of Geometry) will no doubt determine once in their lives to become *figure-casters* and so vote them all to be throwen into the fire; if some good body doe not reprieve them for pyebottoms, &c., for which you know analogical numbers are incomparably apt, if they be accurately calculated." In 1641, Pell tells us that he received Warner's analogical tables from the

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[2] MS. Birch, 4280. This letter is dated August, 7th 1644 from Amsterdam.

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author, and he adds that "the booke itselfe was of large paper, length 11, breadth 9 inches: 100 pages."[3]

In the British Museum[4] there are three tracts by Walter Warner, transcribed by Hunt. Smithson: the first is on tangents, the second on the "commixture of metalls," and the other is entitled "Radii optici definitiones," written in 1634, and is the identical MS. which Pell says[5] he received from Cavendish in 1640.

Dr. Hutton tells us that Birch procured Pell's mathematical papers for the Royal Society, and that there were several treatises by Warner amongst them. I have not yet had an opportunity of ascertaining whether any such papers are in the possession of that Society, but I think it extremely probable that those which Hutton refers to are the same which are now in the British Museum, and that they were prevented by some accident from reaching their intended destination. But then, where are Warner's MSS. which are stated to be with them? the only one that can be conjectured with any probability to be written by him, is a tract in No. 4409, "De analogicis canonibus."

Newton's letter to Pell, mentioned at page 28, affords an additional proof for the priority of his claim to the invention of fluxions. After giving the fluxional method of finding the subtangent to a curve, he adds:—"This, sir, is one particular, or rather a corollary, of a general method which extends itselfe without any troublesome calculation, not only to the drawing tangents to all curve lines, whether geometrick or mechanick, or however related to straight lines or to other curve lines, but also to the resolving other abstruse kinds of problemes about the crookednesse, areas, lengths, centres of gravity of curves, &c. Nor is it (as Hudden's method de maximis et minimis, and consequently Slusius, his new method of tangents as I presume,) limited to æquations which are free from surd quantities. This method I have interwoven with that other of working in equations by reducing them to infinite series. I remember I once occasionally told Dr. Barrow, when he was about to publish his Lectures, that I had such a method of drawing tangents, but some divertisement or other hindered me from describing it to him."

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[3] MS. Birch, 4411,

[4] MS. Harl. 6755. and 6756.

[5] MS. Birch, 4417. folio 34.

THE END.

CAMBRIDGE:
PRINTED BY METCALFE AND PALMER, TRINITY STREET.

ON THE MEANS OF RENDERING LARGE SUPPLIES OF WATER AVAILABLE

IN CASES OF FIRE;

AND

ON THE APPLICATION OF MANUAL POWER

TO THE

WORKING OF FIRE ENGINES.

By JAMES BRAIDWOOD, Assoc. Inst. C. E.

ABSTRACT OF THE PAPER, AND OF THE DISCUSSION UPON IT.

EXCERPT MINUTES OF PROCEEDINGS

OF THE

INSTITUTION OF CIVIL ENGINEERS.

LONDON.

1844.

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LONDON:
Printed by William Clowes and Sons,
Stamford Street.

INSTITUTION OF CIVIL ENGINEERS.

June 18, 1844.

The PRESIDENT in the Chair.

No. 688. "On the means of rendering large supplies of Water available in cases of Fire, and on the application of manual power to the working of Fire Engines." By James Braidwood, Assoc. Inst. C.E.

Supplies of Water for Fires, Fire Engines, &c.

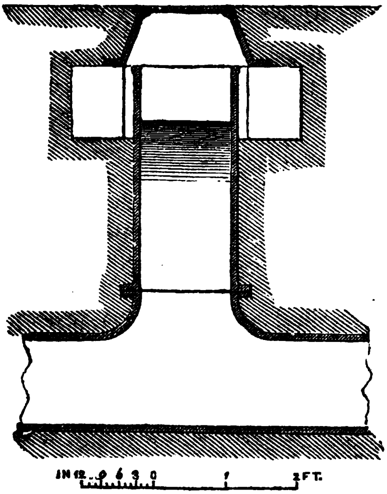
The plans at present in use, are so few and simple, that it is conceived merely necessary to state the quantity of water required, and to describe the most approved modes of supplying it, in cases of ordinary fires.

If water can be obtained at an elevation, pipes with plugs or fire-cocks on them, are preferable to any other mode at present in use. The size of the pipes will depend on the distance and elevation of the head, and also on the size of the buildings to be protected. It may be assumed as a general rule, that the intensity of a fire depends, in a great measure, on the cubic content of the buildings; distinction being made as to the nature and contents of such buildings. If no natural elevation of water can be made available, and the premises are of much value, it may be found advisable to erect elevated tanks; where this is done, the quantity of water to be kept ready and the rate at which it is delivered, must depend on the means possessed of making use of the water.

The average size of fire engines may be taken at two cylinders of 7 inches diameter, with a length of stroke of 8 inches, making 40 strokes each, per minute. This sized engine will throw 141 tons of water in six hours, and allowing one-fourth for waste, 176 tons would be a fair provision in the tanks for six hours' work; this quantity multiplied by the number of engines within reach, will give an idea of what is likely to be required at a large fire. If however there are steam engines, to keep up the supply through the mains, the quantity of water kept in readiness, may be reduced to two hours' consumption, as it is likely that the steam engines would be at work before that quantity was exhausted. This is what may be supposed to be required, in case of serious fires in dockyards, in large stacks of warehouses, or in large manufactories.

Where water can be had at nearly the level of the premises, such as from rivers, canals, &c., if it is not thought prudent to erect elevated tanks, the water may be conducted under the surface by large cast iron pipes, with openings at such distances as may seem advisable for introducing the suction pipes (Fig. 1.) This plan should not be adopted, where the level of the water is more than 12 feet below the surface of the ground, as although a fire engine will, if perfectly tight, draw from a much greater depth than 14 feet (2 feet being allowed for the height of the engine), still a very trifling leakage will render it useless for the time, at such a depth.

Fig. 1.



Opening for Suction pipe.

The worst mode of supplying engines with water, is by covered sunk tanks; they are generally too small, and unless very numerous, confine the engines to one or two particular spots, obliging the firemen to increase the length of the hose, which materially diminishes the effect of the fire engine. If the tank is supplied by mains, from reservoir, it would be much better to save the expense of the tank and to place plugs, or fire-cocks, on the water-pipe. Another evil in sunk tanks, is, that the firemen can seldom guess what quantity of water they may depend upon, and they may thus be induced to attempt to stop a fire, at a point they would not have thought of, if they had known correctly the quantity of water in store.

Where sunk tanks are already constructed, they may be rendered more available by a partial use of the method shown in Fig. 1.

A great deal has lately been said as to extinguishing fires by jets from water mains, without the use of fire engines. This, no doubt may be done under particular circumstances, where the pressure is considerable, the pipes large, and if only one or two jets are required; but at large fires, where ten or twelve jets are necessary, the expense would be too considerable, especially, as where the largest fires may be expected, water is generally least wanted for other purposes; besides, it appears wrong in principle, to employ a power, which decreases exactly in proportion to the extent to which it is used, independent of the great loss by friction in the leather hose, which reduces the delivery, and of course the height or force of the jet, 2½ per cent. for every 40 lineal feet of leather hose, through which the water passes, as was fully shown by the following experiments.

Memoranda of experiments, tried on the mains and service pipes of the Southwark Water Company, between 4 *and* 9 A.M. *of the* 31*st January* 1844. *The wind blowing fresh from N.N.W.*

The pressure at the water-works at Battersea, was kept at 120 feet, during the experiments, and every service pipe or other outlet was kept shut.

1*st. Experiment.*—Six standcocks, with one length of 2½ inches riveted leather hose 40 feet long, and one copper branch 4 feet to 5 feet long, with a jet ⅞ inch in diameter on each, were placed in six plugs on a main 7 inches diameter in Union Street, between High Street, Borough, and Gravel Lane, Southwark, at distances of about 120 yards a part. The water was brought from the head at Battersea, by 4250 yards of iron pipes 20 inches diameter, 550 yards of 15 inches diameter, and 500 yards of 9 inches diameter.

1st. One standcock was opened, which gave a jet of 50 feet in height, and delivered 100 gallons per minute.

With four lengths of hose the jet was 40 feet high, and the delivery

92 gallons per minute. When the branch and jet were taken off, with one length of hose, the delivery was 260 gallons per minute.

2nd. The second standcock was then opened, and the jet from the first was 45 feet high.

3rd. The third standcock was opened, and the jet from the first was 40 feet high.

4th. The fourth standcock being opened, the first gave a jet of 35 feet high.

5th. The fifth being opened, the first gave a jet of 30 feet high.

6th. All the six being opened, the first gave a jet of 27 feet in height.

2nd Experiment.—Six standcocks were then put into plugs, on a main 9 inches diameter in Tooley Street, the extreme distance being 450 yards, with hose and jets as in the first experiment. The water was brought from the head at Battersea by 4250 yards of iron pipes of 20 inches diameter, 1000 yards of 15 inches diameter, 1400 yards of 9 inches diameter. The weather was nearly the same, but the place of experiment was more protected from the wind, than in Union Street.

1st. With one standcock open, a jet 60 feet in height was produced, and 107 gallons per minute were delivered.

2nd. The second standcock was then opened, and the difference in the first jet was barely perceptible.

3rd. Other two standcocks being opened, the first jet was reduced to 45 feet in height, and the delivery to 92 gallons per minute.

4th. All the six standcocks being opened, the first jet was further reduced to 40 feet high, and the delivery to 76 gallons per minute.

3rd Experiment.—Two standcocks, with hose, &c., as in the first experiment, were then put into a service pipe, 4 inches diameter and 200 yards long, in Tooley Street, the service pipe was connected with 200 yards of main 5 inches diameter, branching from the main of 9 inches diameter. The weather was still the same as at first, but the wind did not appear to affect the jets, owing to the buildings all round being so much higher than the jet.

1st. The standcock nearest the larger main was opened and a jet of 40 feet high was produced, delivering 82 gallons per minute.

2nd. Both standcocks being opened, the first gave a jet of 31 feet, and delivered 68 gallons per minute.

3rd. The standcock furthest from the large main, only being opened, gave a jet of 34 feet, and delivered 74 gallons per minute.

4th. Both standcocks being opened, the furthest one gave a jet of 23 feet, and delivered 58 gallons per minute.

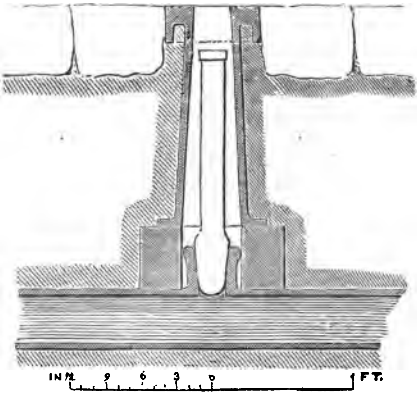
When both these plugs were allowed to flow freely without hose, the water from that nearest the large main, rose about 18 inches, and the farther one about 1 inch above the plug-box.

These and other experiments, prove the necessity of placing the plugs on the mains, and not on the service pipes, where there are mains in the street.

The different modes of obtaining water from the mains or pipes are shown in the accompanying drawings.

(Fig. 2) is a section of a common plug when not in use.

Fig. 2.

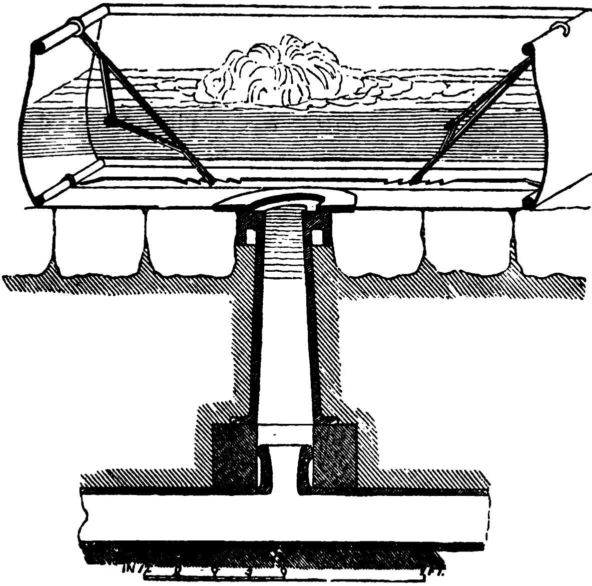


Common Fire-plug.

(Fig. 3) is a section of the common plug, with a canvas dam or cistern over it, as used in London. The cistern is made of No. 1. canvas, 15 inches deep, extended at top and bottom by ⅝ inch round iron frames, a double stay is hinged on the top frame at each end. When the cistern is used, the top frame is lifted up, and the stays put into the notches, in two pieces of hoop iron, fixed to the bottom frame. There is a circular opening 9 inches diameter in the canvas bottom, two circular rings of wash-leather about 2 inches broad, are attached to the edges of the opening in the canvas, so as to contract it to 4 inches or 5 inches diameter; the plug being opened, the cistern is placed over it; the wash-leather is pressed down to the surface of the road by the water, and a tolerably water-tight cistern, with about 12 inches or 14 inches of water in it, is immediately obtained.

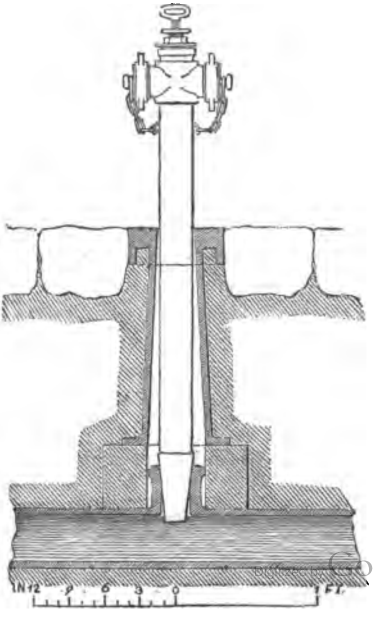
(Fig. 4) is a plug with a standcock in it, to which hose may be attached.

Fig. 3.



Fire-plug with canvas Cistern.

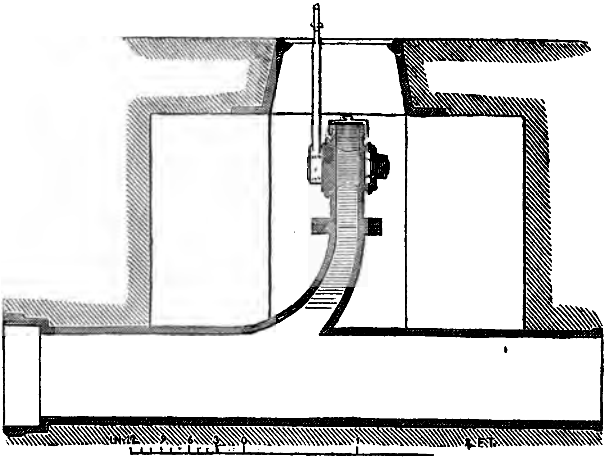
Fig. 4.



Plug, with Standcock.

(Fig. 5) is a common single firecock with a round water-way $2\frac{1}{2}$ inches diameter.

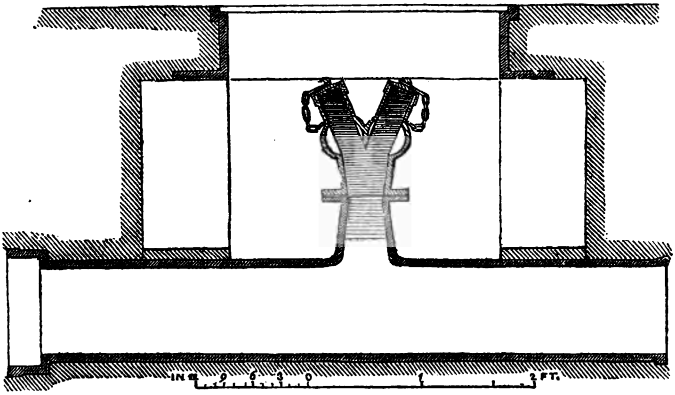
Fig. 5.



Single Fire-cock.

(Fig. 6) is a double firecock, as laid down in Her Majesty's Dockyards.

Fig. 6.



Double Fire-cock, used at the Royal Dockyards.

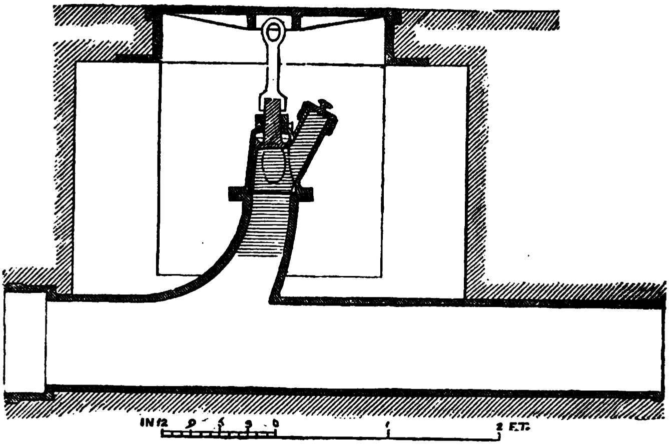
It will be observed, that the short piece of pipe between the main and this firecock is not curved to the current of the water, but merely opened a little; this is done with a view of increasing the supply by steam power, and as the steam engines are, in most cases, situated in a different direction from the tanks or reservoirs, therefore, the curve

Google

that would have assisted the current in one direction, would have retarded it in the other. It has been objected to these firecocks, that the opening does not run through the centre of the key, therefore only one side of the key covers the opening in the barrel, while in the common firecock both sides are covered.

(Fig. 7) is a double firecock, as laid down at the British Museum.

Fig. 7.



Double Fire-cock, used at the British Museum.

This has a very good delivery, and is certain to be always tight, if well made, as the pressure of the water forces the key into the barrel; this also renders the cock somewhat difficult to be opened and shut, if the pressure be great; but as a lever of any length may be used, and the key, from its perpendicular position, may be loosened by a blow, this objection is, in a great measure, obviated.

In Figs. 5 and 6, the openings in the street are large enough to admit of the levers for opening the cock to be fixed, that no mistake may occur from the lever being mislaid; but with those at the British Museum, it was not thought necessary to have fixed levers, as a crow-bar, or anything that could be introduced into the eye of the spanner, would open them.

The plug and firecock have both certain advantages and disadvantages, which the author describes.

The plug, with a canvas cistern, is the easiest mode of obtaining water; the plug-box being only the size of a paving-stone, is no annoyance in the street, and the water has only one angle to turn before it is delivered.

On the other hand, where the supply of water is limited, the plugs give but little command of it; there is, however, comparatively very small loss at a large fire in London, from this cause, as it is very seldom, that all the fire-engines can be supplied direct from the plugs, and those that arrive late, must pick up the waste water as they best can, by using another description of canvas dam, or opening the street; but in enclosed premises, especially where the water is kept for the purpose of extinguishing fires, firecocks are much to be preferred. It is very difficult to insert the standcock into a plug, if there is a considerable force of water, and if the paving has moved, it cannot be done without raising the plug-box; but this is, however, the easiest mode of using firecocks, and where there is a considerable pressure of water, if the watchmen or the police are supplied with a hose reel and branch pipe, they can, in enclosed premises, direct a jet on the fire while the engines are being prepared, and if they cannot reach the fire, they will have water ready for the engine when it arrives.

Inclosed premises are particularly mentioned, because the principal duty of the watchmen, in these cases, is to guard against fire and their other duties being comparatively few, the men are not often changed, and they can be instructed thoroughly in the matter. With the general police of the metropolis it is quite different, their duties are so numerous and varied, that to add that of firemen to them would only be to confuse them.

Firecocks, if kept at 9 inches to 12 inches below the surface, are easily protected from frost, by stuffing the opening with straw.

The advantage which the double firecocks have over the single ones, is merely the increased water-way, as a firecock 3½ inches diameter could not be so easily opened or shut, as two cocks of 2½ inches diameter.

One of the greatest objections to firecocks, is the very large openings required in the streets, the first cost and the repair of which are both considerable, besides their liability to accident. To take them to the foot-path, increases the expense and diminishes the supply of water, as it is generally done with a small pipe, and the number of angles is increased. In some instances, where firecocks have been put down on one side of the street, no less than four right angles have been made in the course of the water; and if the fire happens to be on the opposite side of the street from the firecock, the thoroughfare must be stopped. The expense also is no slight consideration, for if laid along with the water-pipes, each firecock, if properly laid, and the pit built round with cement, will cost eight or ten times as much as a plug.

On the application of manual power to the working of Fire Engines.

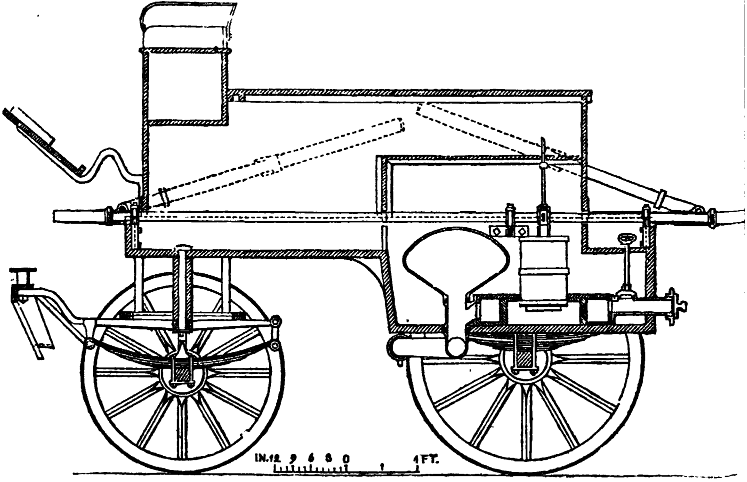
Fire Engines

In the application of manual power to the working of fire-engines, the principal object is, to apply the greatest aggregate power to the lightest and smallest machine; that is, suppose two engines of the same size and weight, the one with space for 20 men to work, throws 60 gallons per minute; and the other with space for 30 men, throws 80 gallons in the same time; the latter will be the most useful engine, although each man is not able to do so much work as at the former.

The reciprocating motion is generally preferred to the rotary for fire engines. Independent of its being the most advantageous movement, a greater number of men can be employed at an engine of the same size and weight; there is less liability to accident with people unacquainted with the work, and such as are quite ignorant of either mode of working, work more freely at the reciprocating, than the rotary motion. To these reasons may be added, the greater simplicity of the machinery.

Various sizes of engines, of different degrees of strength and weight, have been tried, and it is found that a fire-engine, with two cylinders of 7 inches diameter, and a stroke of 8 inches, can be made sufficiently strong at 17½ cwt. If 4 cwt. be added for the hose and tools, it will be found quite as heavy as two fast horses can manage, for a distance under 6 miles, with five firemen and a driver (Figs. 8 and 9).

Fig. 8.



Fire Engine, used by the London Fire Brigade.
Longitudinal section,—with the Levers turned up for travelling.

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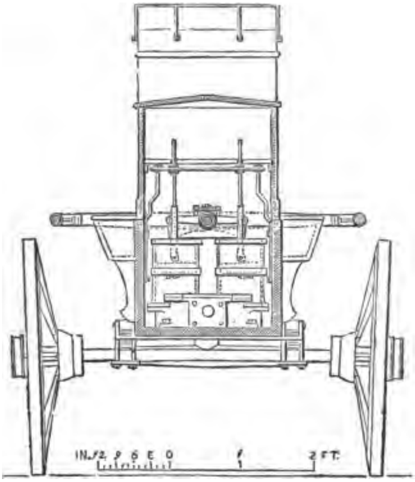
Fig. 9.

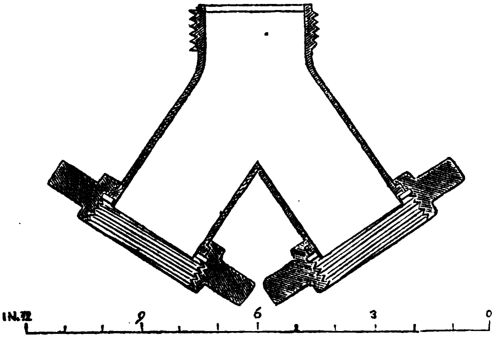


Transverse section.

This size of engine has been adopted by the Board of Admiralty and the Board of Ordnance, and its use is becoming very general.

When engines are made larger, it is seldom that the proper proportions are preserved, and they are generally worked with difficulty, and soon fatigue the men at the levers. When a large engine is required in London, two with 7 inch cylinders are worked together by means of a connecting screw (Fig. 10), thus making a jet very nearly

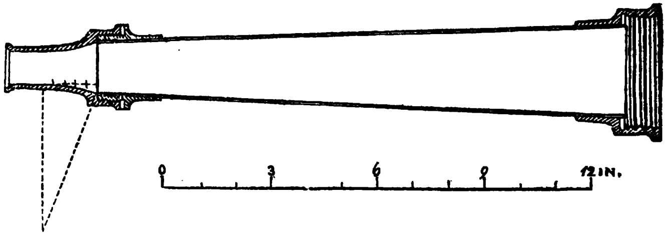
Fig. 10.



equal (as 98 to 100) to that of an engine with cylinders 10 inches diameter; any larger size than this cannot be used, as the friction in the hose of 2½ inches diameter, is so much increased that the jet is comparatively weak; the hose may of course be enlarged in diameter, but the weight is augmented, and the whole of the machinery is rendered more unwieldy and less useful.

A great many different shapes of jet have been tried, and that shown in Fig. 11 was found to answer best when tried with other

Fig. 11.



forms. The old jet was a continuation in a straight line of the taper of the branch, from the size of the hose screw, to the end of the jet pipe; this had many inconveniences; the size of the jet could not be increased without making the jet pipe nearly parallel. As the branches were sometimes 7 feet or 8 feet long, in some instances the orifice at the end of the jet-pipe, was larger than that at the end of the branch. The present form of the jet completely obviates this difficulty, as the end of the branch is always 1½ inches diameter.

The curve of the nozzle of the present jet is determined by its own size; one-[illegible] half of the difference between the jet to be made and the end of the branch, is set up on each side of the diameter of the upper end of the branch, a straight line is then drawn across, and an arc of a circle described on this line, from the extremity of each end of the diameter of the jet, until it meets the top of the branch; the jet is then continued parallel, the length of its own diameter; the metal is continued one-eighth of an inch above this, to allow of a hollow being turned out to protect the edge. The rule for determining the size of the jet for inside work is, to " make the diameter of the jet one-eighth of an inch for every inch in the diameter of the cylinder, for each 8 inches of stroke. The branch used in this case is the same size as shown in Fig. 11. When it is necessary to throw the water to a greater height, or distance, a jet one-seventh less in area is used, with a branch from 4 feet to 5 feet long.

The usual rate of working an engine, of the size described, is forty strokes of each cylinder per minute, this gives 88 gallons. The number of men required to keep steadily at work for 3 or 4 hours is 26; upwards of 30 men are sometimes put on when a great length of hose is necessary. The lever is in the proportion of 4¼ to 1. With 40 feet of leather hose and a ⅞ inch jet, the pressure is 30 lbs. on the square inch; this gives 10·4 lbs. to each man to move a distance of 226 feet in one minute. The friction increases the labour 2½ per cent. for every additional 40 feet of hose, which shows the necessity of having the engine, and of course the supply of water, as close to the fire as is consistent with the safety of the men at the levers.

The paper is illustrated by nine drawings (Nos. 3650 to 3658), showing the fire-engines, fire-plugs, cocks, hose-screws, jets, &c.

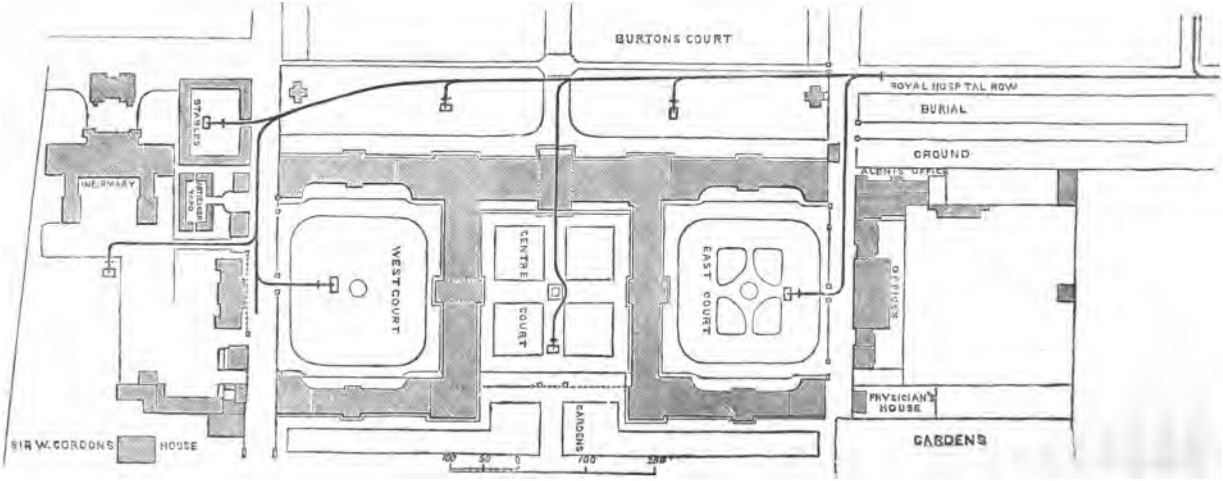
Mr. J. Simpson.

Mr. Simpson said, that the subject of Mr. Braidwood's communication was liable to so many contingencies, that it became one of extreme difficulty to lay down comprehensive rules on the question.

In rendering supplies of water available, in cases of fire, the question to be solved was, what were the appliances most likely, under all circumstances, to prove serviceable in sudden emergencies, taking into account the effect of alarms of fire, and the excitement caused by them, among all classes of persons.

In the course of his practice, he had designed and executed plans for affording supplies of water in case of fire, and it was a subject to which he had occasionally paid considerable attention. He was sorry to differ, in any degree, from so good an authority as Mr. Braidwood, but he thought that the services of sunk tanks, or underground receptacles, were improperly undervalued; in small water-works, where the power of the pumping machinery was limited, and in comparatively level countries, when elevated reservoirs of magnitude could not be constructed, he knew of no plan so likely to succeed as sunk tanks; because with trifling attention, they were not liable to be deranged, or to be affected by frost, and they were so immediately available in the hour of need; the large quantity of water required to be supplied in a short time at fires, being usually, far beyond the pumping power of small water-works. He had frequently applied tanks with success. In the fire supply at the Royal Hospital at Chelsea, of which he presented a plan (Drawing No. 3659, Fig. 12), which he designed a few years since for the Commissioners of Her Majesty's Woods, Works, &c., three tanks, containing 5000 gallons each, were introduced, in compliance with the desire of one of the officers, in order to obtain half-an-hour's supply of water for the fire-engines of the establishment, and thus to avoid delay and afford time to communicate with the turncocks. The tanks were supplied by

Fig. 12.



Royal Hospital, Chelsea.—Supply of Water in case of Fire.

+ Firecock.

☐ Tank.

independent pipes connected with the water-works' main; supplies being also introduced into the building. He intended originally to have laid communicating pipes, at a low level, to admit the water to flow from any of the tanks, to those which might be in use, but vaults and other obstructions deterred him from following out this arrangement, and it was now questionable whether, with the direct communication with the water-works' main, it would have proved worth the cost of the application.

There were many situations, where it would be nearly impossible to have elevated supplies, of any considerable extent, and in such positions he must contend for the advantage of sunk tanks. For instance, in a very flat country, or in such a position as at Windsor Castle, which was situated upon an abrupt knoll, nearly 100 feet above the river, with the elevated land 4 miles distant; at Hampton Court Palace, where notwithstanding the proximity of the river and other sources whence water could be procured, unless sunk tanks existed in the court-yards, to which instant access could be obtained, much injury might happen before a regular supply of water could be given, and great engine power would be wasted, in pumping it by hose from such a distance as from the river.

He concurred with Mr. Braidwood in all he had stated respecting the supply to fire-engines, but the impossibility of fixing plugs to meet all cases, and to supersede long lengths of hose, was so great, that he despaired of its accomplishment. He believed we were indebted to the Dutch for the introduction to this country, of a large portion of the present system of fire-engines and apparatus. When King William III. landed in 1688, a quantity of fire-engines and implements were brought from Holland, and up to a recent period some of them were still to be found, in several of the public buildings in London. The workmanship of the pump barrels and valves, was excellent, and the style of their construction, would be creditable to the shops of our best makers, in the present day. In the year 1817, he had examined similar engines and apparatus in Cape Town, Cape of Good Hope, where the Dutch system of fire supply remained in the same state as at the capture of that colony in 1804. The Dutch were, apparently, well aware of the disadvantages of working the water from fire-engines through long lengths of hose; their fire-engines were supplied with canvas pipes, tanned inside, fitted with funnels, for conveying water from a distance to the fire-engines; and he had seen similar pipes used at Manchester, Liverpool, and other towns in England.

He was impressed with the idea, that fire-engines were too frequently inefficiently supplied with hose-pipes. At the fire at the

Burlington Arcade, a few years ago, long lengths of hose were indispensable, and in confined courts and passages, where fire-engines could not be worked, they were equally necessary. At a recent fire at Gravesend, he had been informed, that one of the engines was comparatively useless, for want of longer hose.

One of the great difficulties at fires, was to prevent the water from running into the sewer gratings, and to the lower parts of the roads and streets away from the sites of the fires. Some idea of the quantity of water consumed at fires might be formed, from the fact that when the houses of Parliament were burnt down, a body of water equal to one acre in area and 12 feet deep, was supplied, and twenty-three jets of water were playing at one time.

The best way of obtaining water from the mains, was not very obvious. Plugs were the simplest contrivances, and were most generally used, but they had disadvantages as well as advantages; where cocks could be applied, they were certainly preferable, but he did not approve of cone cocks; the water-ways were contracted, and the cones were liable to become set and otherwise deranged, and also to be frozen. Latterly he had applied the common screw or slide cock, used in water-works; in them, the water-ways were not contracted, and so far as his experience went, he was inclined to give a decidedly favourable opinion of them. A well-made slide cock, with gun-metal screws and nuts, would, he had no doubt, with occasional packing, last 30 years, and with trifling repairs, 30 years more.

Objections had been frequently urged to the common stand pipes, and indeed to the use of cocks in cases of fire, as being detrimental in some respects to obtaining the water, and to their affording an opportunity for one or two engines to monopolize the supply, to the exclusion of others; all firemen being anxious to work without the suction pipes being laid, as they too frequently were compelled to be placed, in dirty kennels or in holes dug in the streets, for the purpose.

A simple mode of rendering the standcocks tight was adopted at Liverpool and Manchester; a recess was turned near the lower end, around and in which hemp strands were wrapped, and it was found, that this made a good water-tight joint, when the end was inserted into the plug-hole. The lower end of the plugs should be of a parabolic form, so as to be readily loosened, when they required to be removed. Mr. Simpson was induced to think, the canvas cistern over the plug-hole, the best mode of obtaining water, in the streets, for extinguishing fires.

Objections had been urged against contracted water-ways, in such apparatus. The absorption of power by contractions in the water-ways of all fire-engine work, was seriously detrimental, the increased power required, being directly in proportion to the contraction of the water-ways. The improvements in fire-engine machinery had, of late years, been very great; in the manufacturing districts engines were used with working barrels of 9 inches or 10 inches diameter, while those in London were only 6 inches and 7 inches in diameter.

At the Royal Hospital at Chelsea (Fig. 12), before alluded to, supplies of water were introduced into the buildings in cisterns, each containing 750 gallons, with a chamber engine in each floor or ward; leather pipes and cocks were connected with the tanks, and were kept in safes, to supply the engines, which were so constructed that one man could work an engine and direct the jet at the same time (Drawing 3660). This system was applied in several large buildings, and it had worked most successfully; many instances had occurred of fires in rooms being extinguished at the outset, with trifling quantities of water.

At the Royal Mews at Pimlico, a large tank, containing 4250 gallons of water (Drawing No. 3661), was erected at a height of 8 feet above the ground, fitted with pipes and valves, which reacted on the line of pipes when the water main was turned off, so that the buildings had an independent supply, and, in case of a fire occurring, time was afforded to communicate with the turncocks. From the beneficial effects he had seen produced, on many occasions, by small quantities of water, at the outbreaks of fires, he was decidedly of opinion that all buildings should be furnished with such supplies and the means of applying them.

It was, he thought, unfortunate, that what might be denominated the preventive system, was not more appreciated by the public, and followed out to a greater extent. The matter was, however, very perplexing; what he had known to succeed admirably under one management, failed from neglect ten years after under another, and the destruction of the building was the consequence.

If the system of using effectively a small quantity of water, on the first outbreak of a fire, was adopted, the loss which now almost uniformly occurred from the employment of such an excess of water would be avoided. It had been stated, that recently at Oxford, goods of the value of £10,000, had been damaged by water, in a fire-proof cellar, while a fire was being extinguished in the building above. These goods would have escaped all injury, but for the excess of water by which they were inundated.

Mr. Simpson agreed with Mr. Braidwood, that jets direct from the main could not be applied with advantage, unless very large pipes, at an enormous cost, were laid down for the purpose; and even then, a connected series of pipes, of any extent, would be liable to so many casualties, that he should hesitate to rely solely upon them. He had, however, often seen one or two jets from mains, applied with success. A fire at the Foreign Office in Downing-street, about two years ago, was extinguished by this means; but in general, jets from mains would be found insufficient in number, and altitude, to extinguish fires of magnitude; dependence, therefore, should not be placed upon them.

The maintenance of plugs in a proper state, in the streets of the metropolis, was a source of constant labour and anxiety; that which would answer in a small town, would not suffice in a large city. He had frequently seen the plugs on the main started, by the vibration of the heavy traffic, and considerable damage ensued before the flow of water could be stopped.

In the spaces before many of the public buildings, firecocks were fixed in tanks, large enough to contain the suction pipes of five engines; the cocks being fitted with screws, to which filling pipes and branches for jets, could be attached; he believed these had answered extremely well, but they were of course more expensive than plugs.

He was now engaged, under the Commissioners at Liverpool, in executing a complete system of water supply for fountains, for extinguishing fires, and for watering the streets. The head of water, in many parts of the town, would be equal to about 180 feet, and he apprehended some difficulty in controlling the plugs; it was probable that he should use for that purpose, a modification of the common slide cock. The metropolitan fires were generally mere pigmies, in comparison with those he had witnessed at Liverpool. Warehouses covering many acres had been destroyed, with their contents, at one fire, and the value of the cotton consumed had equalled £1000 per hour for days together.

It had been said that the supplies of water, and the means of extinguishing fires, were less effective at the present period than they were twenty years ago. He believed that opinion to be very erroneous; the number of fires arrested in their progress at the present day was very great. To illustrate this position he had drawn up in a tabular form the result of observations upon two districts, each consisting of 20,000 houses, situated on the north and on the south side of the Thames.

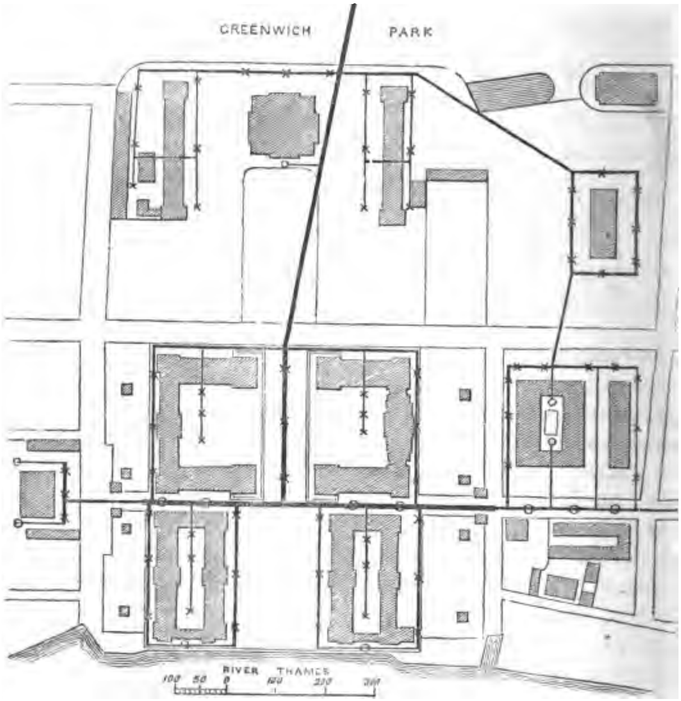
	District comprising 20,000 Houses, north of the Thames.				District comprising 20,000 Houses, south of the Thames.		
Date.	Fires in Chimneys.	Fires in Houses, Buildings, &c.	False alarms, when the Turncocks drew Plugs, when the water was not wanted.	Total of Turncocks' Attendance in case of Fire.	Fires in Chimneys.	Fires in Houses, Buildings, &c.	False Alarms in the five Years.
1838	35	15	23	73	..	..	..
1839	38	12	27	77	5	17	..
1840	66	23	18	107	10	24	..
1841	50	31	32	113	12	26	..
1842	56	22	28	106	61	46	..
1843	..	..	..	..	94	42	1241
	245	103	128	476	182	155	1241
Average	49	20	26	95	36	31	248

In comparing the practice of former days with that of the present time, and speaking from recollection only, he should think, that a quarter of a century ago, about one-half the number of fires were attended by fire-engines at an early stage, and the disorganized state of the engine attendants was productive of serious evils. These were now remedied, and it was surprising how rapidly the intelligence of fires was communicated to the station, and the promptitude with which the engines attended. This, he believed, was in a great degree to be attributed to the system introduced by Mr. Braidwood in the Fire Brigade. The supposed increase in the number of fires, might, he believed, be traced partly to the increase of buildings, but, in a great degree, to the variety of furnaces introduced into buildings for warming and ventilating, also from carelessness in not shutting the main supply cocks of the gas-pipes leading into dwellings every night; he thought that the increased publicity given to fires through the press had influenced the opinions he had referred to. He felt confident it would be found, that in fact the number of fires in the metropolis had not increased proportionably beyond that of the extension of buildings, although during the last ten years many of the fires, which had occurred, appeared certainly to have been of greater magnitude than formerly.

Mr. Braidwood presented drawings of the system of distribution of water-pipes at the British Museum (No. 3657) and Greenwich Hos- Mr. Braidwood.

pital (No. 3658, Fig. 13), showing the situation of the fire-cocks. The works at both places were executed nearly in accordance with his report to the Commissioners on the subject. The latter building would be supplied from a reservoir in the park under a pressure of nearly 100 feet, and the former by the New River Company with a pressure of about 80 feet.

Fig. 13.



Royal Hospital, Greenwich.—Distribution of the Fire Main.

× Single firecock.
○ Double ditto.
—— Main, 6 inches diameter.
—— ,, 9 ,, ,,
—— ,, 12 ,, ,,

Mr. Braidwood presented the following abstract of the fires in London during eleven years:—

Abstract of Fires in London for Eleven Years, 1833—1843.

Year.	Lives Lost.		Totally Destroyed.		Considerably Damaged.	Slightly Damaged.	Gas.			Total Fires.	False Alarms.	Chimney Alarms.	Total Alarms.	Total of Fires and Alarms.
	Strangers.	Firemen.	Number of Buildings Totally Destroyed.	Number of Fires at which one or more Buildings were Totally Destroyed.			Fires caused by Gas.	Gas in Premises.	No Gas.					
1833	6	..	32	31	135	292	24	96	362	458	59	71	134	592
1834	3	..	46	28	116	338	25	130	352	482	57	112	169	651
1835	11	..	45	31	125	315	37	172	299	471	66	106	172	643
1836	14	..	51	33	134	397	38	195	369	564	66	125	192	756
1837	13	..	27	22	122	357	34	203	298	501	82	134	216	717
1838	24	..	40	33	152	383	42	228	340	568	79	108	187	755
1839	25	..	19	17	165	402	40	250	334	584	70	101	171	755
1840	24	1	36	26	204	451	58	236	445	681	84	98	182	863
1841	8	4	27	24	234	438	45	300	396	696	67	92	159	855
1842	20	..	33	24	224	521	52	331	438	769	61	82	143	912
1843	15	1	40	29	231	489	36	311	498	749	79	83	162	911
Total .	163	6	396	298	1842	4383	431	2452	4071	6523	770	1117	1887	8410

LONDON:
Printed by William Clowes and Sons,
Stamford Street.

[Floating Fire Engines]

THE NEW SYSTEM

OF

PATENT HYDRAULIC PRESSURE STEAM NAVIGATION,

WITHOUT THE USE OF
PADDLE WHEELS, FLOATS, SCREW PROPELLERS,
INTERNAL WATER WHEELS, OR FORCE PUMPS,

AND WHICH IS BASED UPON AN ENTIRELY DIFFERENT PRINCIPLE
TO ANY AT PRESENT PRACTISED,

INSURING FOUR TIMES THE USUAL VELOCITY,
AT ONE-FOURTH THE ORDINARY COST.

Universally Secured:

PATENT FOR THE UNITED KINGDOM AND COLONIES

Dated the 16*th September*, 1853.

LONDON:
PRINTED FOR AND PUBLISHED BY THE PROPRIETORS, MESSRS. KNOCKER AND
HIGGINSON, AT THE PATENT HYDRAULIC PRESSURE STEAM NAVIGATION
OFFICES, No. 4, ADAM'S COURT, OLD BROAD STREET, CITY.

1854.

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DESCRIPTION

OF THE

PATENT HYDRAULIC PRESSURE

EAM NAVIGATION APPARATUS.

EAR the stern of any vessel aft in the Run on each side eath the line of flotation, a pair of steam-engine cylinders, , of about eight feet stroke are placed in a horizontal sition, one nearly above or over the other. When extreme locity is not the object contemplated—in merchant or ding vessels for instance—one engine and propulsion pipe, on each side, will be sufficient; and therefore to describe e complete apparatus is all that is necessary,—those neath, when two sets are used, resembling the others in ery particular.

Referring therefore to the annexed drawing, Fig. 1, shows n elevation of this system of propulsion. Fig. 2, a horiontal section made through the lower cylinder. Figs. 3, 4, re the vertical and horizontal sections. Fig. 5, an end view of a species of shut-off, RR showing stop-cocks for a imilar purpose; and Figs. 6, 7, 8, 9, are head and stern ections of a vessel, defining the position of the propulsion ipe apparatus.

The letters NN are slide bars, between which traverse the ide blocks OO, of the crosshead BB. The end of the steam aster rod DD, is let into the crosshead BB, and attached to it by rings AA, and by screw-bolts, that penetrate likewise through the end of the propelling piston rod CC, which in like manner is let into, fixed and secured to the opposite side of the crosshead BB, by the rings and bolts described.

The propelling piston rod C, is fitted into a cylinder pipe or tube TT, denominated a propulsion pipe, of about fifteen inches diameter and nine feet long, the outer end of which propulsion pipe is inserted and secured in an orifice bored through the vessel's bottom as close down to the keel as possible, and consequently the water from without finds its way freely into such pipe. The propelling piston C, within the propulsion pipe T, is set in motion by the impulse of the steam piston D, which acts in the same horizontal centre line, in consequence of the ends of both the steam and propulsion piston rods D and C being firmly attached and secured opposite each other to the crosshead BB.

In despatch vessels or men of war however, when two sets of apparatus are used one above the other on each side, it must be borne in mind that the pistons in the upper set of apparatus move in opposite directions to those below, their reciprocating action being so regulated that one set of steam and propulsion pistons shall always be at the end of their stroke when the others are at the beginning, the object o which arrangement is, like that of cranks placed at righ angles, to equalize the work of the engine at the differen points of its stroke.

The opening and vacuum presented under water by th rifice and bore of the propulsion pipe T (when its piston s drawn in towards the centre of the vessel, by the act the steam piston D) is immediately filled by a column of water equal to the contents of such pipe, which from being always below the line of flotation is necessarily kept constantly full by atmospheric pressure on the surface of the water, the projectile influence of fluids at different depths or points of descent, and other causes, whence bodies immersed —whether in motion or not—are pressed upon in every direction with an equal force. This column of water so admitted within the pipe T consequently presents a resisting surface or medium to the backstroke of the propelling piston C when made sternward; which resisting power of the water column is increased by a current tendency to rush into the pipe T created in the external fluid by the indrawing of the piston or pistons in adjacent propulsion pipes. This impulsive water pressure into pipe T, and concomitant additional resisting quality, is also augmented by the local following movement of the surrounding fluid as it closes upon and fills the vessel's track or wake, to restore the level of that portion of water surface displaced by the passage of the ship. For it should be observed, that this invention is simply an internal rowing a vessel ahead by pressure at right angles upon water or hydraulic columns, with solid round propellers or pistons instead of oars,—the necessary feathering of the oar blade being compensated for by each propelling piston C moving forward, in the air vacuum existing between its inner surface and the stuffing box, to renew its sternward or propelling stroke. Which strokes, acting upon a column of water perpetually pushed forward with indescribable force, will drive any vessel—as a moveable body—to the head of such water column (precisely as a boat is pulled forward to where the oar-blade is immersed, not the water swept astern) and that too with immense velocity, at a rate in fact at least four times greater than can be obtained by the use of either paddle wheels or screws. Because, the propelling power of the paddle is only derived from that portion of water surface acted upon by the float from the moment it is immersed until it attains a perpendicular position, after which it generates back water:—while the screw (?) propels solely by sculling, or cutting diagonally, and thence pushing forward on that section of fluid contained between the blades, vanes or arms of the propeller. In either case, but a portion of such a column of water as the present invention insures being acted upon by an equally solid (piston) surface, applied at right angles to the direct purpose of propulsion, with little friction to overcome, and no heavy machinery to move; consequently, the size of the boilers, the space they occupy, and the consumption of fuel, may all be proportionately diminished, and ample room provided for the stowage of a full supply of coal for the longest voyage in ordinary bunkers. This system of marine propulsion possesses likewise the advantages of not needing any external protruding fittings or encumbrances whatever outside the body of the ship; nor will any part of the internal machinery ever require unshipping if applied to sailing vessels—the action of the rudder also remaining unaltered, and not in any way obstructed, neutralized or interfered with. Placed low down near the keel of the ship, injury to the machinery by shot is rendered nearly impossible; and, as regards comparative size of engines, those upon this principle of one hundred and fifty nominal horse power would be sufficient to propel a First Rate.

The steam engine cylinders M, are supplied with steam in he usual way. As to valve gear, it can be arranged in the upper cylinder as figures 1 and 2 show it, namely, the slide valve may be moved by one of the slide blocks OO, of the lower cylinder (when two are used) and vice versa—or, an alternate reciprocating stroke of the engines practically accomplished by any other known mechanical means, such as the adaptation of cranks and expansion rods to that purpose.

When repairs, re-stuffing, or other circumstances render it necessary that the open extremities under water of the propulsion pipes T should be closed, they may be shut either by stopcocks RR, placed horizontally to be accessible to a spanner; or, by such a slide or sluice scuttle, as that shown by figures 3, 4, 5, which scuttle works in a frame E, inserted into the iron or wood framing of any vessel, and may be raised or lowered by the rack F and the pinions PP adapted to that purpose, either on deck or in the hold.

In ordinary cases, the bows of a ship or craft are perforated on both sides low down near the forefoot Z, and a propulsion pipe placed and secured in each orifice, with steam cylinders attached, working horizontally in a plane parallel to the vessel's course—they are called into action when it is necessary to make a sternboard, care being taken to stop the engines abaft before those forward are thrown into gear.

In vessels however intended only for short passages or river purposes, where the size of the boiler is of less moment, the propulsion piston C of this invention can be set in motion by high pressure steam supplied direct from the boilers, without having a condensing engine at all; in which case (high pressure) a double piston or plunger CCC, will be required in the propulsion pipe T, for if the external water is allowed to fill the entire length of the pipe at every stroke, such propulsion pipe T must thereby be rendered so cold as would instantly condense any quantity of steam admitted therein.

It is necessary also to point out, that the sketch drawing annexed shows only the principle of the invention, and one mode of steam application to it; but the patent right extends to setting these propelling pistons in motion by any other mechanical or motive power, whatever or whosesoever may be the steam or other engines, adapted to this system of propulsion; and also to every description of perforation made in such propelling pistons C, and the fitting or arrangement of valves in them; likewise to the adaptation of every kind of slide valve to the propulsion pipes T, by which their combined power (propulsion pipes and pistons) may be in any way increased, altered or reversed, so that in cases where complication of machinery is not objected to, their reversed action or retractive suction (to be produced by alternately lessening and subdividing the external orifices of the propulsion pipes T, by means of shifting slides, scuttles or valves) may be so regulated, as to do away with the necessity of having a separate backing engine forward.

To render all kinds of ships more buoyant in heavy seas, which is an object that necessarily forms a portion of this invention—for the interests of humanity—and with a view of obviating hereafter the danger of foundering at sea, instead of using the ordinary watertight compartments, galvanized iron cases of any required size, airtight and protected from collapse by internal iron crosswires, stays or supports, are to be placed inside close against the ship's external plating or planking, to serve as a lining in iron vessels, or be contained within that of wooden ones. These cases will communicate with each other by an airtight pipe, led along all round the vessel beneath the decks, against the lining, under the beams; each case having a separate neck furnished with a stop-cock V, communicating with the main pipe W, by which cock any case, if injured, may be shut off from the rest with a spanner. By means of a flexible tube attached when necessary to the boilers, the whole series of cases fore and aft can be filled with steam through screw nozzles, opening one on the starboard and the other on the port side of the ship; and an escape of steam through the opposite screw nozzle would prove that the atmospheric air in the cases was displaced. Then by disconnecting the tube, and screwing iron tops with gutta percha cushions upon such nozzles, the whole of the cases and pipes being thus rendered air-tight will, when the steam within them is condensed, afford as near a vacuum as is necessary for all practical purposes, and most certainly sufficient to prevent a vessel so fitted from foundering:—the tightness of the cases and existence of the vacuum being easily at any time ascertained, renewed or maintained, by refilling the cases with steam from the Boilers or Coppers.

Working drawings according to scale will be supplied for engines ordered, when the nominal horse power and the size of the vessel they are intended to propel are specified.

As was the case respecting increased rates of travelling by railways when first proposed, the practicability of attaining greatly superior velocities at sea has not only been disputed but unhesitatingly pronounced impossible. Such allegations, however, known facts and actual experience refute, as is demonstrated by simply adverting to the speed with which the larger kinds of fish (material bodies wholly immersed, which ships are not) displace fluids and force themselves through the water upon precisely the same principle on which this system of propulsion is based, namely, the striking the fluid at right angles with a flat resisting surface. Respecting the efficacy of this mode of progression, Professor Anstead M A, F R S, F G S, remarks, in his "Ancient World," page 171:—"Such a tail would be of the greatest possible utility in producing rapid motion through the water, a power possessed to an almost incredible extent by some of the larger and more voracious fishes, such as the shark, and one which in them transcends any locomotive power that man has yet been able to attain, exceeding even that which birds possess in their familiar element the air." A pigeon notwithstanding has been known to fly two hundred and forty miles in two hours.

The proprietors' right under this patent embraces the means of propelling ships vessels and boats of every description, by piston pressure acting in the manner stated, upon columns of water admitted in pipes tubes or cylinders of any size or form within such vessels—by the designation or title of, PATENT HYDRAULIC PRESSURE STEAM NAVIGATION; which is in fact an internal rowing ahead of any floating moveable body; and the use of such pistons, whether perforate or imperforate, and with or without valves fitted in such perforations; together with the use of the pipes, tubes or cylinders, named propulsion pipes, as well in their simple as compound form, of any size or shape, with or without valves, shifting vanes or scuttles, thereunto adapted, whereby their action may be in any way ltered or reversed—and also, the turning of cranks by hydraulic pressure, for these or other purposes. Their patent right likewise comprehends the simple direct mode of applying steam, or other motive or mechanical power to such pistons and propulsion pipes, by the junction of the steam and propulsion piston rods at one crosshead, working with slide blocks, and slide bars, as sketched in the annexed drawing.

And, as to insure additional buoyancy to vessels, is a necessary part of this invention, the proprietors' right extends also to the application of galvanized iron or other airtight cases supported from collapse internally, and from within which the atmospheric air has been displaced or otherwise exhausted for that purpose; a portion of this invention, that is applicable to vessels of every kind as a security against the danger of foundering at sea, obviously preferable to the water-tight compartments now commonly used.

Waterlow & Sons, Printers, Carpenters' Hall, London Wall.

THE ENGRAVINGS AND LETTER-PRESS OF THIS CATALOGUE
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J. TYLOR AND SONS'

ILLUSTRATED CATALOGUE

OF

FIRE ENGINES,

FOR 1854.

WARWICK LANE, NEWGATE STREET, LONDON.

ENTERED AT STATIONERS' HALL.

W. AND B. BROOKE, PRINTERS, LINCOLN.

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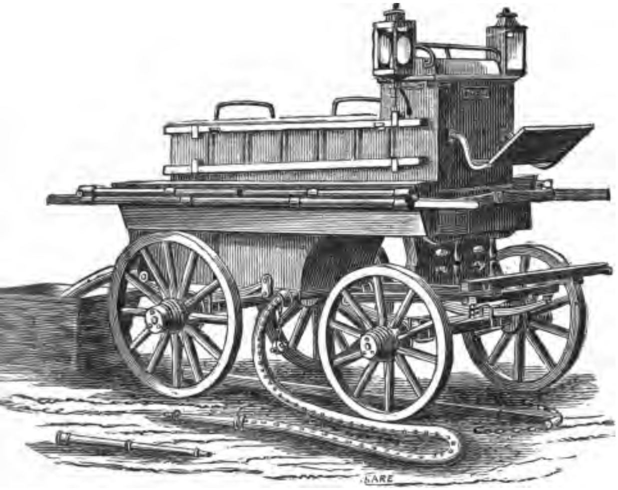
J. TYLOR AND SONS'
LLUSTRATED CATALOGUE
OF
FIRE ENGINES.



J. TYLOR AND SONS'
IMPROVED FIRE ENGINES.

J. Tylor and Sons' Improved Fire Engine for 30 men, with two 7-in.
metal barrels, with 8-in. stroke ; gun metal plungers and valves ; (the
rovement in these valves consists in the peculiarity of their formation, by
ch they can be turned back and examined or cleaned, even when at a fire,
minute's notice, without taking the Engine to pieces, which must be
e with all other Engines) ; fitted in mahogany cistern, with side pockets
suction hose and branch pipes ; top box for stowage of delivery hose,
; with driving seat and foot board, mounted on best town-made spoke
els, with long-bolt mail axles with gun metal caps, on best springs ; fore-
ing carriage with pole, whipple trees, drag handle, and wrought-iron fold-
levers to handles at both ends of Engine. The whole of the very best
ription of material and workmanship, painted in oil and varnished, with
following appurtenances :—

One each long and short branch pipes, with gun metal jets ; one strong
per suction strainer, with gun metal swivel ; three hose wrenches.

This Engine will throw 133 gallons per minute 120 feet high.

The London Fire Brigade use this size Engine ONLY.

For estimates of Fire Engines see pages 4 to 7.

Warwick Lane, Newgate Street, London.

No. 1, FIRE ENGINE.

	£.	s
J. Tylor and Sons' Improved Fire Engine for 30 men, with two 7-in. gun metal barrels, 8-in stroke, &c., as per preceding description	143	1
This Engine will throw 133 gallons of water per minute 120 feet high.		
Extra if wrought iron forelocking carriage, instead of wood, which gives a lighter appearance to the Engine, with the same strength	15	0
Extra if with suction cock, with spanner outside the back of Engine. The object of this cock is to simplify the arrangement of changing the working of Engine from the cistern to the suction hose, or, *vice versa;* and has the advantage of not being liable to be unsound, which might occur by the ordinary screw cap, on bottom piece, not being carefully screwed down after working the Engine from the cistern, and which would prevent its effective working	6	0
Two 6-ft. lengths 3-in. copper rivetted leather suction Hose Pipe, with galvanized iron spiral and gun metal screws, fastened and tied on with copper wire—per 6-ft. length, 2*l.* 12*s.* 6*d.*	5	5
Six 40-ft. lengths 3-in. copper rivetted leather delivery Hose Pipe, with gun metal screws tied on with copper wire—per 40-ft. length, 6*l.* 8*s.* 4*d.*	38	10
One 20-ft. ditto	3	11
Extra for Loops for fastening hose to ladders, and straps for ditto —per length, 4*s.* 6*d.*	1	11

The Hose Screws are cut to the Government and Brigade guage.

For Complete London Equipment—see page 17.

No. 2, FIRE ENGINE.

J. Tylor and Sons' Improved Fire Engine for 24 men, with two 6-in. gun metal barrels, 8-in. stroke, &c., &c., as per preceding description	135	0
This Engine will throw 98 gallons per minute 120 feet high.		
Extra if wrought iron fore-locking carriage	15	0
Extra if suction cock as before described	6	0
Two 6-ft. lengths 2½-in. copper rivetted leather suction Hose Pipe, with galvanized iron spiral and gun metal screws, fastened and tied on with copper wire—per 6-ft. length, 2*l.* 2*s.* 6*d.*	4	5

Fire Engines.—*Continued.*

	£	s.	d.
Six 40-ft. lengths 2½-in. copper rivetted leather delivery Hose , with gun metal screws tied on with copper wire—per 40-ft. th, 5*l.* 10*s.*	33	0	0
One 20-ft. ditto ditto ditto	3	2	6
Extra for loops for fastening hose pipe to ladders, and straps ditto—per length, 4*s.* 6*d.*	1	11	6

The hose screws are cut to the Government and Brigade guage.

For Complete London Equipment—see page 17.

No. 3, FIRE ENGINE.

	£	s.	d.
J. Tylor and Sons' Improved Fire Engine for 18 men, with 5½-in. gun metal barrels, 8-in. stroke, &c., &c., as per preceding cription	115	0	0

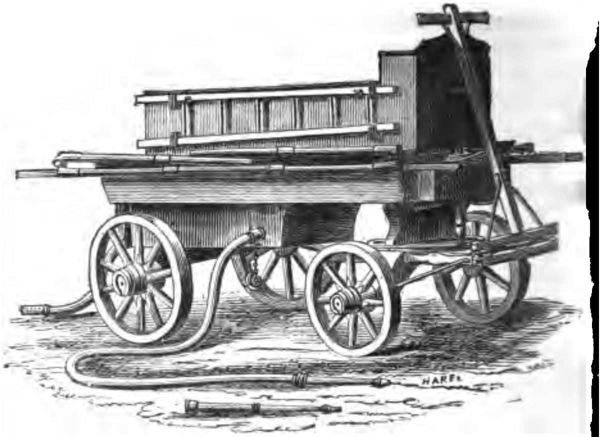
This Engine will throw 68 gallons per minute 100 feet high.

	£	s.	d.
Extra if wrought iron fore-locking carriage	15	0	0
Extra if suction cock as before described..........................	6	0	0
Two 6-ft. lengths 2½-in. copper rivetted leather suction Hose e, with galvanized iron spiral and gun metal screws, fastened tied with copper wire—per 6-ft. length. 2*l.* 2*s.* 6*d.*	4	5	0
Six 40-ft. lengths 2½-in. copper rivetted leather delivery Hose e, with gun metal screws tied on with copper wire—per 40-ft. th, 5*l.* 10*s.* 0*d.*	33	0	0
One 20-ft. ditto ditto ditto ditto..............	3	2	6
Extra for loops for fastening hose pipe to ladders, and straps ditto—per length, 4*s.* 6*d.*	1	11	6

The hose screws are cut to the Government and Brigade guage.

For complete London Equipment—see page 17.

Fire Engines.—*Continued.*



No. 4, FIRE ENGINE.

J. Tylor and Sons' Improved Station Engine for 30 men, with two 7-i gun metal barrels, 8-in. stroke, gun metal valves and plungers: fitted i mahogany cistern, with side pockets for suction hose and branch pipes, t box for stowage of hose, &c.; mounted on best spoke wheels, with forelocking carriage, drag handle, and wrought iron folding levers at both ends Engine, and the following appurtenances:—

	£.	s.	d.
One each long and short branch pipes, with gun metal jets; one strong copper suction strainer, with gun metal swivel; three Hose wrenches	125	0	
This Engine will throw 133 gallons per minute 120 feet high.			
Two 6-ft. lengths 3-in. copper rivetted leather delivery Hose Pipe, with galvanized iron spiral, with gun metal screws fastened and tied with copper wire.—per 6-ft. length, 2*l.* 12*s.* 6*d.*	5	5	
Six 40-ft. lengths, 3-in. copper rivetted leather delivery Hose Pipe, with gun metal screws tied on with copper wire—per 40-ft. length, 6*l.* 8*s.* 4*d.*	38	10	0
One 20-ft. ditto ditto	3	11	8
Extra, for loops for fastening Hose Pipe to ladders and straps for ditto—per length, 4*s.* 6*d.*	1	11	6

☞ *This Engine differs from that shewn in page* 3, not *having springs, long bolt mail axles, or driving seat.*

No. 5, FIRE ENGINE.

	£	s.	d.
J. Tylor and Sons' Improved Station Engine for 24 men, with 6-in. gun metal barrels, 8-in. stroke, gun metal valves and ngers, &c., &c., as per description given	115	0	0
This Engine will throw 98 gallons per minute 120 feet high.			
Two 6-ft. lengths, 2½-in. copper rivetted leather suction Hose pe, with galvanized iron spiral, and gun metal screws, fastened d tied with copper wire.—per 6-ft. length, 2*l.* 2*s.* 6*d.*	4	5	0
Six 40-ft. lengths, 2½-in. copper rivetted leather delivery Hose pe, with gun metal screws, tied on with copper wire—per 40-ft. gth, 5*l.* 10*s.*	33	0	0
One 20.ft. ditto ditto ditto	3	2	6
Extra, for loops for fastening Hose Pipe to ladders, and straps ditto—per length, 4*s.* 6*d.*	1	11	6

☞ *This Engine differs from that shewn in page* 3, *not ving springs, long bolt mail axles, or driving seat.*

No. 6, FIRE ENGINE.

J. Tylor and Sons' Improved Station Engine for 18 men, with vo 5½-in. gun metal barrels, with 8-in. stroke, gun metal valves d plungers, &c., &c., as per description given	98	15	0
This Engine will throw 68 gallons per minute, 100 Feet high.			
Two 6-ft. lengths, 2½-in. copper rivetted leather suction Hose pe, with galvanized iron spiral, and gun metal screws, fastened d tied with copper wire—per 6-ft. length, 2*l.* 2*s.* 6*d.*	4	5	0
Six 40-ft. lengths, 2½-in. copper rivetted leather delivery Hose pe, with gun metal screws tied on with copper wire—per 40-ft. ngth, 5*l.* 10*s.*	33	0	0
Extra, for loops for fastening Hose Pipe to ladders, and straps r ditto—per length, 4*s.* 6*d.*	1	7	0

If without folding levers to handles, deduct £4 10s. 0*d.*

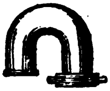
☞ *This Engine differs from that shewn in page* 3, *not aving springs, long bolt mail axles, or driving seat.*

COMPLETE EQUIPMENT OF A LONDON FIRE ENGINE.

IMPROVED STAND PIPE,

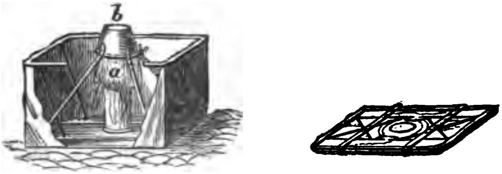
With gun metal cock and bottom piece, bright iron spanner, and £. s.
screw for attaching hose pipe 5 18

This is used for driving into street main plugs, to feed into cistern Engine; it is also very much used for cooling the ruins after fires.



COPPER GOOSE NECK,

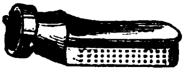
With gun metal swivel, for feeding into cistern of Engine.. ... . 0 17



J. TYLOR AND SONS' IMPROVED FOLDING CANVAS SUCTION CISTERN,

With leather cap 4 5

This is used for placing over street main plugs, to form a reservoir for the suction hose to work from; (*a*) represents the column of water, and (*b*) the leather cap, preventing the rise of the column above the cistern. This cistern folds up in a very small compass.

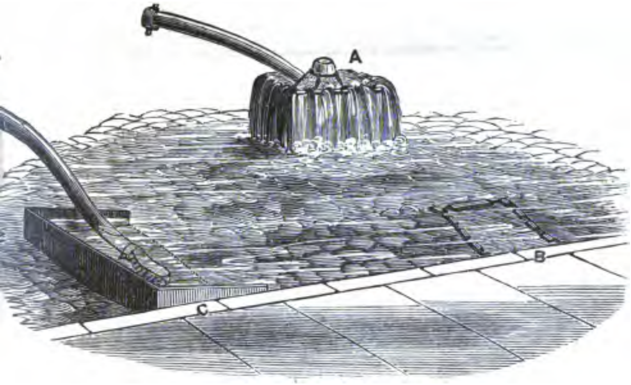


COPPER SUCTION STRAINER,

With gun metal swivel, for 3-in. suction hose. 1 9
2½-in. Ditto................................. .... 1 4

Warwick Lane, Newgate Street, London.

ETHOD OF WORKING TWO OR MORE ENGINES FROM ONE MAIN PLUG.



A) Canvas Suction Cistern, with suction hose working from it.

B) Canvas Drain Cloth, with lead weights, laid over the street grating, to prevent the waste water escaping.

(C) Folding Canvas Gutter Dam, with wood sides, in which the waste water accumulates, forming a reservoir for the suction hose of another Engine.

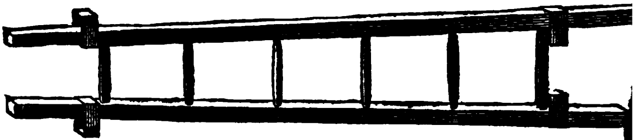
Canvas Drain Cloth, with lead weights..............................	0	11	6
Folding Canvas Gutter Dam, with painted wood sides...........	1	1	0

For price of Folding Suction Cistern—see page 8.

COPPER SUCTION SYPHON,

With Gun Metal Swivel	1	14	6

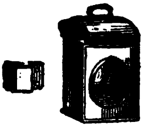
n case of a short supply, or when the water will not rise in the street , this Syphon is screwed on the suction hose, and put down the plug Engines have been worked for hours from *the dead water lying in the pipes.*



LADDER FOR FIXING TO SIDE OF ENGINE,

As shewn in engraving, page 3. These ladders are made with wrought iron sockets, so that any number will fit together. Each Engine carries one pair ....per pair £ s 2 12

If purchased separate from the Engine, painting charged extra.

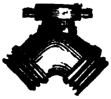


IMPROVED FIRE ENGINE LAMPS.

These Lamps are so constructed, as to be readily detached from the Engine; and are provided with a handle on the top, for convenience of carrying into buildings ....per pair. 1 16

GUN METAL BREECHING PIECE,

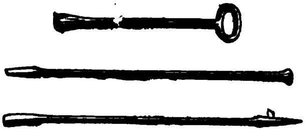
For working two Engines into one Branch Pipe........................ 1 16



GUN METAL BREECHING PIECE,

For working two Branch Pipes from one Engine 1 16

Warwick Lane, Newgate Street, London.



TURNCOCK TOOLS,

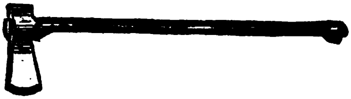
	£	s.	d.
nsisting of water-cock key, crow bar, and spoon bit for clearing ; plug hole .... per set.	0	12	6

SPADE

4s. 3d. each.

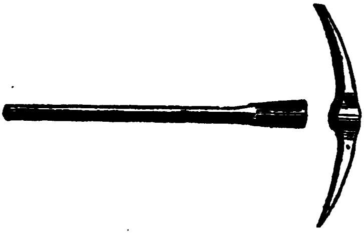
SAW,

ith Leather Sheath........	0	13	9



LARGE POLE AXE,

11s. 6d. each.



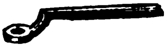
PICK AXE,

/ith Loose Handle	0	6	6

BOAT HOOK OR PREVENTER,

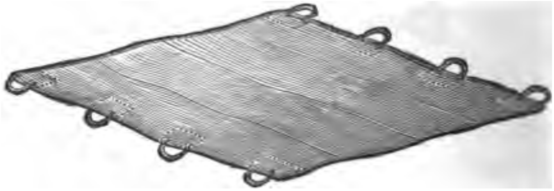
7s. each.

This is used for pulling out sashes or hangings, &c. that may be on fire.



HOSE WRENCHES,

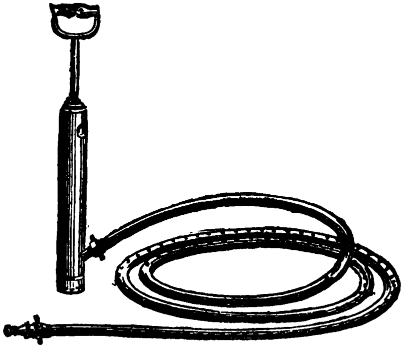
4s. 3d. each.



CANVAS JUMPING SHEET,

£1 9s. each.

This is bound with rope, and has rope handles for 8 men, to hold under the person about to jump from the building on fire.



PORTABLE FIRE PUMP,

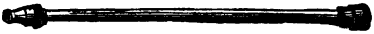
	£	s.	d
With 10-ft. of Hose Pipe and Jet..	2	5	0

This is much used by the Brigade in London ; and found very effectu at the commencement of a fire. The water is brought to the room in t bucket, or pail, as may be most convenient.

PORTABLE FIRE PUMP,

	£	s.	d.
Galvanized Iron Pail, with 10 Feet Hose	2	17	6

These ought to be kept ready for use in public buildings, large factories, &c.



COPPER BRANCH PIPE,

t. 6-in. long, with gun metal screw and jet	1	16	0

COPPER BRANCH PIPE,

. 6–in. long, with gun metal screw and jet	1	3	0

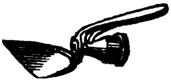
SHORT GUN METAL JETS.

in.	⅝ in.	11-16ths in.	¾ in.	13-16ths in.	⅞ in.
6d.	6s. 6d.	6s. 6d.	6s. 6d.	7s.	7s. each.

LONG CONICAL GUN METAL JETS.

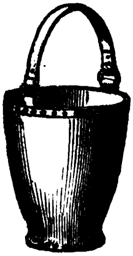
.	⅝ in.	11-16ths in.	¾ in.	13-16ths in.	⅞ in.
.	12s.	12s.	12s.	12s.	12s. each.

These Jets are recommended for altitude.



GUN METAL REGISTERED SPREADER 18s. 6

This is found useful for surface fires.



LEATHER FIRE BUCKETS.

	£	s.	d
Two Gallon Copper Rivetted Leather Fire Buckets painted inside and outside ....each.	0	9	6

Canvas Folding Fire Buckets ....each.	0	4	3

These are always carried in the London Engines; and each fireman carries one in his belt.

HOSE PIPE.

Best Leather Copper Rivetted Suction Hose Pipe, with galvanized iron spiral and gun metal screws, fastened and tied with copper wire.

3-in. inside diameter per 6-ft. length..................................	2	12	6
2½-in. do. do. do.	2	2	0

This is made in *six foot lengths* for convenience of stowage.

Best Copper Rivetted Leather Delivery Hose Pipe, with gun metal screws tied on with copper wire.

3-in. inside diameter per 40-ft. length	6	8	4
2½-in. do. do. do.	5	10	6

This is recommended in 40-ft. lengths, for convenience of stowage in box of Engine; and, when wet, is as much as a man can carry up a ladder, or handle with facility.

PATENT CANVAS HOSE PIPE,

repared by Sir W. Burnett's process, with gun metal screws, tied on with pper wire.

	£	s.	d.
2¾-in. per 40-ft. length	2	18	0

This Hose Pipe stows in a smaller compass than the leather hose pipe ; ıd is used as an addition where more than is usually carried by the Engine required. It is not suitable for use in towns, as it becomes cut by being agged over the stones ; but answers well for most country fires.

GUN METAL HOSE SCREWS.

3-in.	per pair.	1	1	6
2½-in.	"	0	13	6

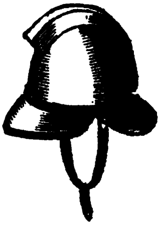
These Screws are cut to the Government and Brigade guage.

IRECTIONS FOR DRESSING LEATHER HOSE PIPE AFTER USE.

After the Hose has been used, wash it and cleanse it from mud, and hang up to dry ; when in a half-dry state, apply the Patent Oil with a brush or onge ; let it remain till quite dry, before rolling it up. When not in use, a tle of the oil applied with the brush, about once in one or two months, will sufficient.

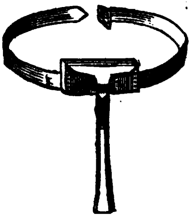
Patent Oil for Hose Pipe, 7*s.* per gallon.

FIREMAN'S EQUIPMENT.



STRONG LEATHER FIREMAN'S HELMET...............	0	13	4

Extra for gilt letters.



FIREMAN'S LEATHER WAIST BELT,	£	s.	d
With Hatchet Case..	0	10	0

FIREMAN'S HATCHET	0	7	9

FOLDING CANVAS FIRE BUCKET .... EACH	0	4	

Each Fireman carries one of these in his belt.

FIREMAN'S UNIFORM.

Of peculiar material, consisting of Grey Frock Coat, Grey Trowsers, Great Coat, Duck Trowsers, Frock or Jacket, and Cloth Cap..	5	17	

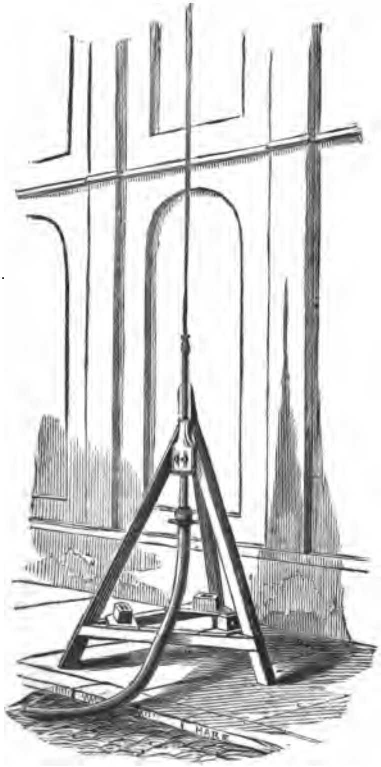
IMATE FOR COMPLETE LONDON EQUIPMENT TO SEVEN-INCH ENGINE.

	£.	s.	d.
ach long and short Branch Pipe [page 13,] included in price of Engine	—	—	—
opper Suction Strainer, [page 8,] included in price of Engine	—	—	—
ose Wrenches [page 12,] included in price of Engine	—	—	—
0 ft. Lengths 3 in. Leather Copper Rivetted Delivery Hose Pipe, with gun metal screws tied on with copper wire—per 40 ft. Length, 6*l.* 8*s.* 4*d.*	38	10	0
0 ft. Length ditto ditto ditto	3	11	8
ra for Loops and Straps, to 7 Lengths, [4*s.* 6*d.*]	1	11	6
ft. Lengths 3-in. Leather Copper Rivetted Suction Hose Pipe, with galvanized iron spiral, with gun metal screws, fastened and tied with copper wire—per 6-ft. Length, 2*l.* 12*s.* 6*d.*	5	5	0
proved Stand Pipe, [page 8,]	5	18	6
ose Neck, [page 8,]	0	17	0
proved Folding Canvas Suction Cistern, [page 8,]	4	5	0
ain Cloth, [page 9,]	0	11	6
tter Dam, [page 9,]	1	1	0
ction Syphon for Dead Water, [page 9,]	1	14	6
Pair of Ladders, [page 10,]	2	12	6
Pair of Improved Lamps, [page 10,]	1	16	0
Breeching Piece for working 2 Engines together, [page 10,]...	1	16	0
of Turncock's Tools, [page 11,]	0	12	6
Spade, [page 11,]	0	4	3
Saw, with Leather Sheath, [page 11,]	0	13	9
Large Pole Axe, [page 11,]	0	11	6
Pick Axe, with loose handle, [page 11,]	0	6	6
Boat Hook, or Preventer, [page 12,]	0	7	0
Canvas Jumping Sheet, [page 12,]	1	9	0
Portable Fire Pump, with 10 ft. Hose, [page 12,]	2	5	0
Each Short Pattern Gun Metal Jet—5-8ths, 3-4ths, 7-8ths, 1, 1-¼ths inch, [page 13,] [6*s.* 6*d.*]	1	12	6
Canvas Folding Buckets, [page 14,] [4*s.* 3*d.*]	1	5	6
Small Three-Square File, for taking burrs off the Hose Screws in case of damage	0	1	6
Bundle of Sheep Skin Strips for stopping Leaks in Hose Pipe	0	0	0
Small Balls of Cord	0	0	0
	£78	19	2

ESTIMATE FOR COMPLETE EQUIPMENT FOR LONDON FIREMA

	£.	s.
Helmet, [page 15,]	0	13
Belt, with Hatchet Case, [page 16,]	0	10
Hatchet, [page 16,]	0	7
Folding Canvas Bucket, [page 16,]	0	4
Uniform, (of peculiar material), consisting of—Grey Frock Coat, Grey Trowsers, Great Coat, Duck Trowsers, Frock or Jacket, and Cloth Cap	5	17
	£7	12 10

TRIALS OF FIRE ENGINES.



In public trials of Fi
Engines, where the obje
is to obtain the greate
result, generally in the fa
of strong opposition, the
fective power of the Engine,
for general purposes, is often
lost sight of; and it becomes
a trial of strength between
the men manning the En
gines. Under these circum
stances, J. Tylor and So
think it necessary to explain
as much as possible, t
method in which the Eng
can be worked to its great
advantage.

Trial of Fire Engines.—*Continued.*

BRANCH PIPE.

ix the Branch Pipe perpendicularly in a strong wood tripod,
n weights to keep it down, as shewn in the preceding
raving, close under the building against which it is to
tried, and as sheltered from the wind as possible.

HOSE PIPE.

Put on as little Suction Hose Pipe and as straight as pos-
le; and let it be very carefully screwed up, so as to be quite
und. The air is drawn through the pores of new suction
se Pipe; but it becomes sound after using a few times.
more Delivery Hose should be used than is actually neces-
y; and there should be no bends or twists in it.

MEN.

The men should be placed so as to have sufficient room to
rk without over-crowding the handles, which does more
rm than good; the heaviest men should be at the centre of
ndles: the strength of the men is required on the down
roke—leaving the up-stroke free for those on the opposite
le of Engine. Pump a few slow strokes to fill the hose
ll out, and then gradually increase in speed, steadily, and
thout jerking, till the stream has reached—say, 80 feet;
w let the men gradually quicken the strokes to the utmost
their strength, for half-a-minute, and the result will be
tained.

It is most important that the men keep accurate time, and
e used to the stroke of the Engine, otherwise power is lost
the striking of the handles against the stops of Engine
rder than there is occasion for. It is certain, that no extreme
sult can be obtained from the pumping of inexperienced men.
few experienced men, placed among the others, to give the
roke, is a great assistance.

In the recent trial of the West of England Engine, worked
the picked men of London, where an astonishing height
as attained, the men made 51 beats of the handles, or 25½
rokes in 15 seconds! in which time, however, the men were
hausted.

Trial of Fire Engines.—*Continued.*

JETS.

The size of jets to be used must, of course, be determined by the power of the Engine; but, as a general rule, ⅛th of an inch in jet, to every inch diameter of barrel, will be the large jet of the Engine; and ⅛th of an inch under that—the jet with which it will throw highest. The large jet will, in a strong wind, often reach higher than a smaller one.

The long conical jets are recommended for height, as they keep the stream better together.

SIZES OF FIRE ENGINES.

It has been found, by long experience, that an Engine with 7-inch barrels and 8-inch stroke, is the size most advantageous for the effectual application of manual power; and, consequently, the London Brigade have discontinued the use of all larger sizes. The weight is adapted for quick conveyance to a fire, which is a most important point; and which cannot be obtained with the large and cumbersome Engines formerly made. Should, however, a larger stream than the ordinary jet be considered necessary, by connecting two 7 inch Engines together with the breeching piece shewn in page 10, an effect nearly as great as that of an Engine with 10 inch barrels will be obtained. This is, however, rarely required. The supply of water, with two Engines, can often be drawn from different points, and used in different parts of the building; whereas, the large Engine monopolizes the whole of the supply, without a proportionate result. In cases, in the Country, where the supply is far distant, one Engine is frequently used to feed another close to the building. In the paper by Superintendent Braidwood, at the Institution of Civil Engineers, he gives it as his decided opinion, that an Engine, of the size above-mentioned, is the most efficient, both for London and Country use; and that any increase of Engine, and, consequently, of equipment, makes it proportionately unwieldy and less useful. He also states, that the gradual discontinuing of larger Engines in the manufacturing districts, is a step in advance in the method of extinguishing fires in this Country.

RULES

FOR

THE FORMATION OF FIRE BRIGADES

IN

COUNTRY TOWNS.

There are four grades of men to form a Brigade.

The first is called the Superintendent, who has the command the Engines, and whose duty is to see that they are in good pair and ready for action. He should be present at all fires; d, being the Principal, on the first report of the fire, should immediately proceed to it, and reconnoitre the buildings around the e on fire; which, when done, he is able, as soon as the Engine rives, to direct its power to that point which may appear to him ost likely to confine the raging element to that part first ignited.

The second is the Foreman, on whom the care devolves of seeg the Engines always ready for action: his duty, at a fire, is to near the Engine, and direct its working, either receiving his structions from the Superintendent, or himself deciding on his e of action as he thinks proper; and, in the absence of the uperintendent, to take the direction of the whole Brigade.

The third goes by the name of Engineer, whose duty is to hold e branch pipe, give orders for a sufficient quantity of hose, and e that the stream of water is directed in the most advantageous anner, on the burning material.

The fourth are the Firemen, whose particular duty is in tting the lengths of hose together in the most expeditious anner possible; rescuing any persons or property from the ildings on fire; and clearing away any obstruction—such as ked walls, burning timber, &c., that may impede the efficiency the Engine.

Warwick-lane, Newgate Street, London.

INSTRUCTIONS.

Immediately on the alarm of "fire!" every man is expected to be at the Engine house, having on his uniform; which, if always kept together in readiness, need not cause a moment's delay.

The five first men—that is, from No. 1 to No. 5—in travelling ride on the left side of the Engine—that being the side on which they must receive the hose from the Engine.

The five men from No. 6 to No. 10, ride on the right side of the Engine, when going to, or returning from, fires.

When the Engine arrives at a fire, the Superintendent, Foreman, and Engineer ONLY are to dismount, and ascertain the means of obtaining a good supply of water, and the best situation for endeavouring to subdue the fire. If circumstances render it necessary for the men to dismount, they must range themselves according to their respective seats, on each side of the Engine, and about a yard distant from it, their faces turned towards it: and, should the Engine move, they must follow at its sides in their proper order, and take up their places as soon as it stops: they will thus be ready to act at a moment's notice, and to keep off strangers from interfering with any of the pipes, pump handles, or other things.

As soon as the line of operation is decided upon, and the Engineer has taken out his branch pipe from the Engine, and ascertained the number of lengths of hose he requires, No. 7 mounts the Engine, for the purpose of giving it out; the first length he gives to No. 1 and No. 2. No. 1 takes the swivel end and screws it to the Engine; when done, he goes forward and makes fast the other joint. No. 2 will roll the length of hose forward, in the direction of the fire, in readiness to affix it to the swivel end of the length that has been left by No. 3. He, (No. 2) will remain in his place to assist No. 1 in making his joint secure; after which, he will return to his place at the Engine. No. 3 wi

Instructions.—*Continued.*

ave been supplied with the second coil of hose, which he is to arry forward to where he thinks the end of No. 2 will reach: he vill then roll his length forward, and act in the same way as No. 2, in readiness to affix it to the length left by No. 4. Nos. 4, 5, and 6 must act in just the same manner, if so many lengths of ose be required—but, previously, Nos. 4 and 5 must get the two andles on the left side of the Engine in readiness for working—he former to take the handle next the front of the Engine: should nore hose be still wanting, No. 2 must go back to the Engine and eceive another coil, and also Nos. 3, 4, and so on, till there be a ufficiency—always remembering that each length of hose reaches 40 feet.

As soon as the Foreman, whose duty it is to attend to the upply of water, has determined from what spot he will draw his upply, he will call for one or two lengths of suction, as he may equire; but, previously, Nos. 8 and 9 must un-strap the portable anvas suction cistern, and place it in readiness for the rose of the uction. No. 8 having a hose wrench, will then take the first ength and screw it to the Engine. No. 9, will (if required,) take the second length, and fasten it to the end of No. 8's length. No. 10 to get the two handles on the right side of the Engine in readiness for working, and also tie the wicker basket on the rose of the suction, as well as take charge of the buckets, ladders, &c. No. 8 should be very particular in having the joints perfectly tight; and also see that the rivets of the suction are upwards. It is the duty of the Foreman to see that the preventer, ladders, and all other things, are removed from the pump handles; that the first buckets are carefully and conveniently laid away, and the fore-carriage of the Engine locked before it begins working.

As soon as the Engine is ready, and a supply of water obtained, Nos. 2, 4, 6, 8, and 10 must, (if considered requisite by the Superntendent,) immediately render assistance for the rescue of property, pulling down buildings, &c.; No. 1 to attend to the suction; and Nos. 3, 5, 7, and 9, remain at the Engine, until it shall be thought advisable, by the Foreman, or Superintendent, to remove them.

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Instructions.—*Continued.*

In moving the hose, when full, the men should be very careful to lay hold of the loops which are fastened round for this purpose; each length of it has two or three of them, and the hose, when it has water in it, should never be moved without, at least, a man at each. In taking up the pipes, the same order is to be observed as in the laying them down, each man coiling up his length and carrying it back to the Engine, where he will find No. 7 in readiness to receive it; in coiling the hose, remember to keep the male screw inside, the swivel screw out, and the rivets also outside.

If any Fireman enter a house when on fire, he should, on no occasion, do this alone; for, when there is a second person, should the first be over-powered by heat, smoke, &c., his companion can, by the leather belt, draw him back, or he may have a rope attached to it, by which means he may with security, enter places in which, without this precaution, there might be great danger. In entering rooms, when on fire, it should always be done on the hands and knees, as the heat, smoke, &c., always rise, the Engineer taking the branch pipe with him; the second, assisting in pulling up the hose.

The Brigade, when travelling, or when on duty, are not to answer any questions, NOR SPEAK TO ANY PERSON but their Fellow-Brigaders; all enquiries must be referred to the Officers. Nor are they to act upon any orders or instructions but those of the Superintendent, Foreman, or Engineer.

THE BRIGADE are expected to perform their duties as silently as possible—order, coolness, promptitude, and dispatch, are indispensable.

If any one of the Brigade should, hereafter, be considered inefficient, or an improper person, his Uniform must be returned to the Superintendent. No one will be allowed to wear the Uniform at any time except when on duty.

Warwick-lane, Newgate Street, London.

OCT 10 1934

Cornelius Walford, F.S.S.